JOURNAL OF DENTISTRY FOR CHILDREN

Published by

The American Society of Dentistry for Children

at

Mount Royal and Guilford Avenues, Baltimore 2, Maryland

Alfred E. Seyler, D.D.S., F.A.C.D., Editor
14615 East Jefferson Avenue, Detroit 15, Michigan

Editorial Board

Sidney Kronfeld Joseph Obst George Higue

Contributing Editors

John Gilster M. Michael Cohen Maury Massler Kenneth A. Easlick
Hugh M. Kopel William F. Via, Jr. Melvin A. Noonan

Issued quarterly in March, June, September and December at Mount Royal and Guilford Avenues, Baltimore 2, Maryland. Subscription price $5.00 per volume (four issues); To members of the A.S.D.C. $3.00 per volume. Single copies $1.25. Changes of address should be sent to the business office, Mt. Royal and Guilford Avenues, Baltimore 2, Maryland. Entered as second class matter at the post office at Baltimore, Md.

Publication in the Journal of Dentistry for Children is not to be taken as an endorsement by the Publishers, the Editors or the Editorial Board.

VOLUME XXII *Second Quarter, 1955* NUMBER 2

CONTENTS

64...From Your President's Pen.....*Willard T. Hunnicutt*

65...Program, National Meeting

66...Orthodontics by Extraction.....*Marvin Davis*

70...Procedures for Adequate Radiographs of Preschool Children
Jess Hayden, Jr., and Albert G. Richards

87...Unit News.....*Melvin A. Noonan*

92...A Stainless Steel Spur-type Space Maintainer.....*Jack Calvert*

96...Behavior Control by Suggestion.....*S. Irwin Shaw*

105...Cavity Disinfecting Agents: A Survey.....*Wilbert C. Fletke*

122...Children's Dental Health Week

from your president's pen

During the past few years there has been an increased interest in the rehabilitation of handicapped children. For the most part this increased interest has resulted in the furtherance of the welfare of the handicapped. The team approach, development of state programs, research projects, etc., has unquestionably produced better care for the handicapped. This should be encouraged and supported by all concerned with helping the handicapped find their places as useful happy citizens.

We, who are a highly specialized health service, can fulfill our obligations by acquiring the "know how" to work with the various involved specialties at the task of reclaiming these children from the "human scrap heap."

The dental needs do not necessarily call for men limited to pedodontics. The answer is in more dentistry, and better dentistry, by general practitioners, wherever they are.

This type of social consciousness will pay huge dividends in satisfaction.

WILLARD T. HUNNICUTT

PROGRAM

National A.S.D.C. Meeting at Sheraton Palace Hotel, San Francisco

October 14, 15, 16

FRIDAY EVENING OCT. 14

Sheraton Palace Hotel

DINNER AND EXECUTIVE COUNCIL MEETING

SATURDAY OCT. 15

Rose Room—Sheraton Palace

9–9:30 OPENING CEREMONIES
9:30–10:30 TELEVISION PROGRAM

OPERATIVE DENTISTRY

JOHN TOCCHINI
ARTHUR DUGONI

ROENTGENOGRAPHY

JOE SWEET
THEODORE GRANT

10:30–10:45 Coffee and orange juice
10:45–12:00 TELEVISION PROGRAM

LOCAL ANESTHESIA

RAY WEINHEIMER
JACK CRAMPTON

12:00–2:00—Cafe Room
LUNCHEON

Warden CLINTON DUFFY—"Prisons, Prisoners and Paroles."

2:00–4:30—Rose Room

STATE DELEGATES AND EXECUTIVE COUNCIL MEETINGS

Sunday Oct. 16—Rose Room

9–9:30 JOHN SOWDEN—A preliminary report on a technic for the remineralization of carious dentin
9:30–10:00 MAX NACHT—Pulpless tooth management—a five year evaluation
10:00–10:40 DAVID LAW—A re-evaluation of treatment of vital exposed pulps
11:00–12:00 PANEL DISCUSSION—IRWIN BEECHEN, moderator
JOHN SOWDEN
MAX NACHT
DAVID LAW
RALPH MCDONALD

Room A—10:00–10:30
EDWARD MACK—Economics and management of children in a dental practice

Rose Room—2:00–5:00 65 Table clinics

Concert and Rose Room—7:00–11:00
Cocktail party and Dinner Dancing with Phil Bavarro and other S. F. entertainers

Orthodontics by Extraction

MARVIN DAVIS, D.D.S., M.S.

To the dentist whose practice is largely constituted of young people, the problem of preventive orthodontic care must repeatedly arise in varying degrees. It is to the credit of many of these dentists that they are including palliative and preventive orthodontic measures within the services of their own offices. Quite often they have the advice and assistance of an orthodontist with whom they may work to solve the more difficult cases and this is an excellent arrangement, for it greatly facilitates the extension of orthodontic therapy to those who might not otherwise receive it.

Yet, there are exceedingly large population areas that do not have adequate dental personnel. The problems that arise for the practitioner who seeks to care for the children of these areas are multifold. The limitations are financial as well as physical. The simplest orthodontic measures are often ruled out by almost insurmountable demands for restoration and extraction of teeth. The only orthodontics that may be considered must fall within these categories.

Several years ago the members of my dental class were divided into small groups and we were sent to various communities in Michigan to gain a picture of dentistry as related to education and public health. My group was sent to a rural area in northern Michigan and I have retained the mental picture of visiting with a dentist who was associated with the Children's Fund of Michigan. He had a mobile dental unit which was moved about within the school system and he would care for all the children within certain age groups. In this manner he made regularly scheduled cycles of appointments. This man practiced under, what seemed to us, very trying circumstances and worked tirelessly to extend his services to as many children as his physical capabilities would permit. I have had reason to think of this experience many times.

A few months ago, I attended a meeting of the Michigan Society of Dentistry for Children which presented a panel composed of three experienced orthodontists who answered pertinent questions concerning the pedodontist and orthodontic care. One of the men in the audience asked the question, "Since I work under circumstances that do not permit the use of mechanical orthodontic appliances, how may I determine which teeth, if any, might be extracted to facilitate the development of a young mouth whose quadrants do not appear to have enough alveolar bone to properly support the canine, 1st premolar, and 2nd premolar teeth?"

By coincidence, this happened to be asked by the same dentist whom I have described and I recognized more of the particular purpose, hope, and intent of this man's question than did most of the others at that meeting. For those dentists who are practicing under similar conditions and must face the same problems, I should like to edit and explain the answers he received.

First, there are simply no universal rules to follow. The most experienced orthodontist must call upon all of his skill in extraction diagnosis and this is

true even with the intended use of appliances. But under the conditions that have been discussed, there are certain factors which may be considered in common denomination. The results are undeniably second best in most instances and perhaps only the more desperate cases should be considered. No case is worth the risk of multilation and not all malocclusion must necessarily be treated per se; for however unattractive or unhygienically disposed, almost all malocclusions are in a functional occlusion. For convenience, we will first discuss the maxillary canine, 1st premolar, and 2nd premolars in this order.

The canine is most usually the last of the three to move into occlusion and for this reason it must most often suffer the consequences of insufficient space. Yet it is the least likely candidate for extraction. There are several reasons for this. It is the cornerstone of the dental arch. It is the point of turning from the anterior biting rim to the posterior ridges. Being the longest of the anterior teeth, it assumes an important role in maintaining a full contour of the lip below the ala of the nose. Its crown's width is proportional to the other anterior teeth, much more so than a substituted premolar. The premolars are similar to one another, but the canine is a singular tooth and the 1st premolar cannot completely replace it to critical observation. The most successful cases considered in the extraction of this tooth are those instances where the tooth has not yet erupted, the 1st and 2nd premolars are in satisfactory occlusion, and the mesial surface of the 1st premolar is within 1 mm of the distal surface of the 2nd (lateral) incisor. If the space is much wider and the canine is partially erupted, its removal will most usually leave a permanent space between the 2nd (lateral) incisor and 1st premolar with probable future spacing between all the anteriors. One very important factor is the axial inclination of the canine. If you can visually ascertain the position of the apex of the tooth, this will guide you in deciding the probability of the movement of the crown. If the apex lies to the far distal of the crown's incisal point, close to the apex of the 1st premolar, the canine may be fairly well depended upon to pendulate from the apical end so that its crown will move distally into the space created by an extracted 1st premolar. If the apical end lies mesially to the crown, there is much less hope for the crown to move distally into an extracted area.

The 1st premolar is the usual choice for extraction. It may be considered a less important tooth than the canine and its absence cannot be detected by the untrained eye when its space has been closed by the adjacent teeth. Although there will often be a permanent space between the canine and 2nd premolar, it is less objectionable visually than a space between 2nd (lateral) incisor and 1st premolar. The erupting canine has every desire to move into the space created with the extraction of this tooth. With orthodontic therapy, this is the tooth most frequently extracted prior to subsequent treatment.

Occasionally, the 2nd premolar becomes the least valuable member of our considered trio in those few cases where the canine and 1st premolar have defied our time table and have fairly well erupted into good occlusion and alignment. The 2nd premolar is either unerupted, impacted, or erupted and displaced to the buccal or lingual. Again, a remaining space must be anticipated but in these instances the alignment of the retained teeth may result in a handsome appearance.

The mandibular canine, 1st and 2nd premolars may be considered much like the maxillary with the exception that it is usually the 2nd premolar which is the last of the three to come into occlusion. In orthodontic practice, it is again the removal of the 1st premolar that is most often favored to relieve crowding. But without orthodontic interception, the 2nd premolar is more often the extracted member. It is most frequently found to be crowded completely out of alignment in the manner described of its maxillary counterpart.

It is impossible to cover the almost infinite variations of cause and effect involved in this problem. I think it important for all practitioners to realize that there is no one sure way for decision upon extraction. It is based upon training and considerable thought and experience. Mother Nature is a marvelous partner but her objectives are not always those of man. When circumstances create doubt as to what should be done, one should recall that there is no way of knowing what the life work of any young person might be. The appearance of their teeth may assume considerable importance to their future careers. They should be permitted to care for themselves in the most desirable way as they become older and we must not jeopardize this alternative. It is very worthwhile to advise these young people of all the possibilites so that they may know just what can be achieved within dentistry. Many young adults will seek out and pay for dental care that their parents or guardians have not afforded to them.

Together with whatever else we may be able to do, we can further educate and assist them toward this goal.

14902 Harper Ave.
Detroit, Mich.

HOTELS IN SAN FRANCISCO

Hotel	Single	Double	Hotel	Single	Double
Alexander Hamilton	$6.50–10.50	$9.00–13.50	Lombard	$4.00– 6.00	$5.00– 9.00
Bellevue		8.00–11.00	Manx	5.50– 7.00	7.50– 9.50
Beverly Plaza	6.00– 7.00	8.50– 9.00	Mark Hopkins	10.00–14.00	14.00–20.00
Biltmore	5.00– 6.00	6.00– 8.00	Maurice	5.00– 6.00	6.50– 8.00
Californian		8.00–10.00	Olympic		6.00–10.00
Canterbury		6.00–10.00	Oxford		6.00– 6.50
Carlton		5.50– 6.00	Pickwick	4.50– 5.50	6.00– 8.00
Cartwright		6.00– 7.00	Plaza		7.00–10.00
Cecil	4.00– 6.00	5.00– 8.00	Powell	3.50– 4.25	4.25– 6.50
Chancellor	5.50	7.50– 8.50	Richelieu	4.00– 6.00	5.00– 9.00
Clift	8.00–14.00	10.00–20.00	Roosevelt	3.50– 5.00	4.50– 7.00
Commodore	4.00– 7.00	6.00–10.00	St. Francis	8.00–18.00	10.00–20.00
Drake Wiltshire	7.00– 8.00	7.50–10.00	San Carlos		3.50– 5.00
El Cortez	5.00– 7.00	6.00–10.00	Senate	4.00	5.00– 6.00
Embassy	4.00– 5.00	4.00– 7.00	Senator	3.50– 3.75	4.00– 5.00
Fairmont	10.50–16.00	13.50–19.00	Shaw	4.00– 5.00	5.00– 6.50
Fielding	4.00– 7.00	5.00– 9.00	Sheraton-Palace	8.00–13.00	10.00–17.00
Franciscan	3.50– 5.00	5.00– 9.00	Sir Francis Drake	8.50–14.50	10.50–19.50
Golden State		5.00– 8.00	Somerton	3.00– 4.00	4.00– 7.00
Herald		4.00– 6.00	Spaulding	4.00	5.00– 6.00
Huntington	8.00–12.50	8.00–15.00	Stewart	4.50– 7.00	6.00–12.00
King George	4.00– 5.00	5.00– 8.00	Sutter	4.00– 5.50	6.00– 9.00
LaSalle	5.00	6.00– 7.00	Whitcomb	5.00– 9.00	7.00–12.00

Three Hotels will be reserved especially for A.S.D.C. members: Sheraton-Palace; Drake Wiltshire; and the Sutter. The Sheraton-Palace will host all A.S.D.C. functions.

PLAN YOUR CONVENTION TOUR NOW

San Francisco, your Host City with a heart, will be putting out a red carpet in October for the weary wayfarer whose interest is dentistry for children. The City with its alluring romance, beauty, and many fascinating places to go, will be a paradise regained because your meeting is scheduled in the middle of its Indian Summer, the nicest time of the year.

Make it a pleasure trip as well. Leave plenty of time to visit the Monterey Peninsula, Beautiful Marin, Giant Redwoods, Yosemite National Park and take in Lake Tahoe and famous Reno, Nevada. On your return trip home take the southern route and see Los Angeles, Hollywood, and Las Vegas.

Energetic general chairman, Charles Sweet Jr., has done a terrific job and has the format for the biggest and best national meeting of the A.S.D.C. Capable program chairman Irwin Beechen has likewise done an outstanding job. Our big first for this year will be the closed circuit television program direct from the College of Physicians and Surgeons with a complete post-graduate course in dentistry for children conducted by some of our best clinicians on patients at the school. In addition there will be speakers and many table clinics in dentistry for children. For the first time, we may also have commercial exhibitors at our A.S.D.C. meeting with the latest items concerning the children's dentist. More details on the program will be in your next issue of the Journal.

The theme of the meeting is what the West is famous for, "Practical Dentistry for Children". The meeting headquarters will be the Sheraton-Palace Hotel, San Francisco. Friday evening, October 14, will be the Executive Council dinner of the A.S.D.C. Saturday morning will be registration for the meeting in general. Our speaker for the Saturday luncheon will be the renowned Warden Clinton Duffy, author of "The San Quentin Story". Sunday evening will be a dinner dance honoring Dr. and Mrs. Hunnicutt and officers. Outstanding night-club acts from San Francisco's supper clubs will be featured at the dinner dance.

The committee members for your 1955 National A.S.D.C. meeting are:

General Chairman	Charles Sweet Jr.
Honorary Chairman	Francis Summers
Co-hosts	Carl Ellertson—Pres. No. Calif. Unit
	Elwood Laine—Pres. So. Calif. Unit
Program Chairman	Irwin Beechen
Co-chairman	Don Chatterton
Table Clinics	Emmet Stanton
	Dean Huchel
Publicity Chairman	Francis Bushnell
Registration Chairman	Don Laston
Commercial Exhibits	Bob Burley
Hospitality Chairman	Claude Warden

Procedures for Adequate Radiographs of Preschool Children

Jess Hayden, Jr., D.M.D.*
Albert G. Richards, M.S.‡

It has been said, that if one wishes a specific answer, a specific question must be asked. Preschool children present complex dental patterns which are far different than those of a mere junior-size adult. Normally, at the age of three, all of the primary teeth have erupted and hard tissue has begun to form in all of the permanent teeth except the third molars. Adult radiography, hence, must be adapted to produce radiographs which will aid in answering specific questions about cavities and the special morphology of the primary teeth, as well as the detection of normality and abnormality in the young dentition. Problems arise which are concerned with the absence, presence, or amount of calcification of the permanent crowns, advanced or delayed resorption of primary roots, periapical pathology of primary roots and its effect on permanent teeth, and the detection of the results of traumatic experiences or anomalous development.

Because of the specialized services required by the dentition of the preschool patient, the literature will be reviewed briefly to gain information which will be of assistance in studying the special problems of this age-group such as can be diagnosed with the aid of adequate radiographic surveys. A readily adaptable technic for securing diagnostic radiographs then will be outlined.

* C. S. Mott Foundation Fellow in pedodontics, Hurley Hospital, Flint, Michigan.

‡ Assoc. Prof. Dentistry, School of Dentistry, University of Michigan, Ann Arbor, Michigan.

Such a survey should demonstrate incipient proximal cavities and determine the extent of advanced cavities. The Council on Dental Health of the American Dental Association[2] has reported that dental caries begins early in life. Studies have shown that as many as 50 per cent of all 2-year-old children have one or more carious teeth. If all interproximal cavities are to be found in an early stage, when control measures are most effective, radiographic examination is necessary. It is recommended, hence, that children be examined by a dentist not later than the third year of life.

After examining 157 primary school children by both visual and radiographic methods, Barr[4] concluded:

> "Those operators who elect to depend on clinical examination alone overlook any opportunity for early treatment of nearly half of the proximal cavities that actually are present."

Bodmer[7] reported that no single method of examination was in itself adequate, but that the combination of bite-wing radiographs and visual examination produced the most accuracy in detecting interproximal cavities. Fixott,[11] using clinical experience as a criterion, stated that 25–40 per cent more cavities were detected by radiographic examinations than by clinical examinations alone. He recommended that radiographic examinations begin at 2 years of age in order to follow the development of primary and permanent teeth, and to detect conditions which might lead to malocclusion, abnormal

development and degeneration of the supportive tissues.

Trithart[32] examined children in one grade school, and two additional schools in which the grade and high-school levels were consolidated. Trithart's purpose was to compare the number of proximal cavities found by visual examinations with the number of proximal cavities revealed by bite-wing radiographs.

> "When the proximal cavities in all posterior teeth were recorded for both examinations, the roentgenographic examination proved indispensable, revealing 54.5 per cent, 57.6 per cent, and 111 per cent more cavities in the three schools."[32]

Trithart and Donnelly[32] concluded that radiographs should not replace the examination with the mirror and explorer but rather should be employed as an aid.

Smith,[28] reporting a study which was conducted in the pedodontic clinic of the University of Iowa, stated that only one-third of the patients were found to be examined adequately by means of the mirror and explorer. Unless bite-wings were used as an adjunct, two-thirds of the patients left with undetected proximal cavities.

The significance of the early detection of cavities also was shown by Jarvis.[13]

> "Caries involving the contact points of the primary molars can cause a highly significant loss of arch length. This loss is roughly proportional to the amount of tooth substance lost. Loss of space due to presence of deep interproximal cavities is, in general, more significant than premature loss of the first primary molar."

An adequate radiographic survey also should show the morphologic outline and the relationship of the pulpal and hard tissues according to Bierman,[5] Brown,[6] Lozier,[17] and Morgan.[20] It is obvious that the relationship is of importance in determining operative procedures, for the radiograph may reveal not only a normal, but an abnormal outline, or an aberration such as a dens in dente.[15]

This survey should enable one to diagnose and to estimate the calcification or the environment of the root-end of primary roots.[6, 17] Many times, the primary roots will have resorbed in the absence of permanent successors, or, if resorption does not progress normally, a primary root may deflect the permanent successor from its normal path of eruption.[10, 20, 27]

The environment of the apices of the primary teeth may show some type of dental pathology. Such a pathological process will be displayed by a break in the periodontal membrane. Radiographically this membrane appears as a fine, black line that is closely adapted to the periphery of the root. A break in the lamina dura, which is seen as a fine white line surrounding the periodontal membrane and adjoining the alveolar bone, also is indicative of abnormality.[17] Nearly every type of dental pathology found in adults may be detected in children. These conditions include cysts, odontomes and various types of neoplasms, the early discovery of which will make intervention less drastic.[17, 20] Sweet[30] reported that 20 per cent of all the children whom he examined had pathologic conditions which were identifiable only by radiographs, all of which might have contributed to the crowding of the teeth and facial disfigurement if left untreated. The presence of dental pathology also has been detected by Bierman,[5] Budowsky,[8] Ennis,[10] Morgan,[20] Simpson,[27] and Updegrave.[33]

The extent and quality of the calcification of the crowns of the permanent teeth should be revealed and noted.[2, 18, 20, 29] If the dentist is to apply his radiography, he also must understand the calcification of the teeth.[10] Hess, Lewis and Roman[12] have demonstrated that always calcification is

much more advanced than radiographs indicate. The extent of calcification along the borders of the crown provides the correct information about how much of the total area is calcified; the pulp is covered with an inorganic cap too thin to project a radiographic shadow, whereas approximal sections, which represent a double thickness of mineral, stand out sharply. This distinction is important. By the end of the first year the crowns of the primary molars, as well as those of the incisors (which calcified earlier) are delineated in entirety with their characteristic contour, thus a means of judging density as well as extent of calcification is available. Radiographically, the first permanent molar's calcification is significant at six months and continues until 2½ to 3 years of age. The calcification of the second permanent molars takes place between 2½ or 3 and continues to 7 or 8 years of age.

The development of the bicuspid crowns and the degree of completion of the roots of the primary teeth are aids in comparing a child's physiologic and chronologic ages,[6, 28] and should be so employed in determining operative procedures and planning of treatment. The relationship of the crowns of the permanent anteriors to the primary anteriors is an important consideration in the supervision of occlusion.[5] The calcification of permanent teeth and the exfoliation of the primary teeth should be supervised, for timely intervention may prevent malocclusion.[29] The survey of Lo and Moyer[16] of the influence of the eruptive sequence of the permanent teeth in the determination of a normal or abnormal occlusion has indicated that it is necessary to observe the resorption of the roots of the primary teeth and the sequence of calcification of the permanent teeth from an early age in order that the consequences of an apparently unfavorable sequence of eruption may be averted or ameliorated by timely intervention. In addition to these considerations, any extractions should be preceded by a radiographic examination to determine the size and proximity of permanent crowns to the roots of the primary teeth involved.[17] Damage due to trauma should be clearly visible accord- to Brown,[6] Ennis,[10] and Main,[18] and might involve fractured roots, damage to the unerupted permanent tooth, or complete intrusion or complete displacement of a tooth from the arch.[14]

Anomalous conditions may present themselves in any such survey. For convenience, these conditions may be listed as classified by Brown.[6]

1. *Anomalies of number.* Such anomalies include missing bicuspids, centrals, laterals, or combinations of teeth. It is obvious that such conditions may present problems of the maintenance of the length of each arch and essential esthetics. Also included with the anomalies of number are supernumerary teeth, which usually are anomalous in shape, but which may, at times, present a normal appearance. Their usual position is in the palate, just posterior to the incisors.[6, 33] Sweet[29] has commented that supernumerary teeth may cause midline spacing and Ennis[10] stated that they may cause the maxillary incisors to shift from the normal axial line, to rotate, or to be retained beyond maturity. The necessity of determining anomalies of number also has been stressed by Lozier,[17] Morgan,[20] Sweet[30] and Updegrave.[33]

2. *Anomalies of shape.* Abnormally-shaped teeth develop during morphodifferentiation of tooth structures and include the peg teeth, Hutchinson's incisors and mulberry molars, traumatized incisors (injury to the tooth bud), dilaceration and dens in dente.

3. *Anomalies of position.* Perhaps the most significant of malposed teeth in this

age group are the "ectopic" eruption of the first permanent molars, or the abnormal facial or lingual inclination of erupting permanent teeth.

4. *Anomalies of texture.* Brown[6] and Morgan[20] have stated that hypoplasia of unerupted teeth may be revealed by adequate radiographs, and, according to Koch,[15] hereditary opalescent dentin is not uncommon. This latter anomaly is a generalized defect in the formation of dentin which provides inadequate support for the enamel. As a result, enamel tends to wear and shear readily, creating a characteristic closure in the vertical direction. Obliteration of the pulp chamber may be accompanied by small or entirely obliterated root canals.[6, 15]

Radiographs are important in all preoperative planning of treatment as well as in the preoperative and postoperative evaluation of the partial pulpectomy. Should it be necessary to resort to extraction, radiographs will aid in an accurate evaluation of the need for maintainers of space.[17] Charbeneau[9] has shown that the measurements taken from posterior bite-wing radiographs are of sufficient accuracy to permit scientific observation of spatial changes. Smith[28] has stated that the radiograph is a necessity in diagnosing the need for, and the preparation and setting of a "shoe" space-maintainer supplying the second primary molar when the first permanent molar is unerupted. There is no other means of determining so easily the precise distal length and gingival depth necessary for the "shoe" to engage the mesial surface of the permanent molar.

Many of the radiographs secured during the preschool period may be used by the orthodontist as an aid in diagnosing malocclusions of the mixed dentition. Nance[21] correctly stated that there is a need for improvement in the quality of the radiographs commonly sent to the orthodontist for his use. Many of these radiographs present distortion or enlargement of the teeth.

A review of the literature reveals little unanimity of thought about which type of radiographic survey best serves the needs of preschool children, or at what age such a survey should be initiated.

Thompson[31] stated that children of three or four years of age might be radiographed adequately by the use of No. 0 periapical film packets in the regions of the maxillary and mandibular central, lateral, cuspid and molar teeth and bite-wing films in the right and left posterior regions. When necessary, this survey is supplemented by occlusal and extraoral views. To facilitate the seating of children in an adult dental chair, Thompson has suggested placing a wooden board one foot in width and two feet in length across the arms of the chair and then correctly positioning the back of the chair and the headrest to the patient. Allen[1] has suggested an intraoral survey similar to Thompson's at four years, while Budowsky,[8] as a rule, has employed such a full mouth series commencing at the age of two and one-half years. When patients are uncooperative, developmental anatomy is to be studied, or gross pathology is suspected, Budowsky has advocated the use of an extraoral non-screen film in a cardboard holder. Bierman[5] has used the same type of 12 film (including bite-wings) intraoral examination in children of five years, and Rockman[26] concurred that 12 was the minimum number of films that should be used for children of five years or younger.

Simpson[27] has recommended that a fourteen film survey begin at the age of six years, one which employs three views of the maxillary incisors, one of the mandibular incisors, one of each cuspid region, one of each molar region and two posterior bite-wings. Three films, he thought,

were essential for the maxillary incisor region if a true conception of dental conditions were to be obtained, as the curve of the arch would tend to produce distortion of the images. Because of this distortion and the late eruption of the cuspids, due to the relatively great distance of their crypts from the occlusal plane, he considered it essential to take separate views of the cuspids, rather than to try to include them in the radiographs of the molar regions. Sweet[29] utilized No. 0 bite-wing films for very young children, but recommended the usual ten film examination, supplemented by bite-wings, if the size of the mouth would permit.

Koch[15] has suggested that the routine radiographic examination of children, initiated by the fourth year, should include views of the maxillary and mandibular incisors, and the interproximals of the posterior teeth. Film packets of standard size generally were used, as their greater coverage outweighed any facility offered by smaller packets. Extraoral examinations were substituted if the patient would not tolerate posterior intraoral placement of the film packets. Kelsten[14] also used the regular size of periapical films, of ultra-speed, to obtain one anterior, two radiographs of the cuspid and two posterior radiographs of each jaw. If the children were especially difficult, four posterior and two anterior films comprised the survey. Extraoral films were used when an acute condition presented itself.

Ennis[10] has advocated routine radiographic examinations from the age of three or four years, with exceptions being made for earlier observations when justified by accidents or other anomalous conditions. Right and left extraoral films and an occlusal view of the maxillary anteriors were employed to reveal developmental processes of the teeth and jaws. Intraoral films were to be used at subsequent examinations, the number being governed by the patient under observation and the results of the operator's technic. Ennis has stated that a combination of intraoral and extraoral technics will produce the most satisfactory results.

Updegrave[33, 34] has used regular periapical films (unless a smaller size was necessary) to obtain two posterior bite-wings and an occlusal view of the maxillary anteriors during a child's first visit. This initial survey was supplemented by a full series of films during the radiographic examination and the early treatment of the child.

Main[17] has proposed that the extent of an adequate radiographic survey be determined by the age of the child and his clinical appearance. However, such an examination was to be of sufficient extent to account for all of the necessary teeth at any given age and to determine the presence of supernumeraries and the relative position of the teeth. Main indicated if such a procedure could be accomplished by using twelve regular-size periapical films that the survey was adequate, but that usually additional exposures were necessary, such as extraoral or occlusal films.

Sweet[30] has employed regular-size periapical films in a survey which included mandibular and maxillary anterior occlusal and periapical radiographs of the four molar areas, which were supplemented by bite-wings.

Brown[6] has stated:

> "A complete radiographic survey of most children can be made with right and left posterior bite-wings using Eastman No. 2 film with the addition of maxillary and mandibular anterior occlusal films when indicated. These four films depict the same areas of the mouth as do full-mouth periapical radiographs. How-

ever, the four film survey is less expensive and easier to take."

Richards[22] has radiographed the preschool dentition by using Radia-tized No. 2 periapical film packets to procure maxillary and mandibular anterior and maxillary posterior occlusal radiographs. Posterior bite-wings (No. 0 or No. 2)*, used in conjunction with right and left lateral jaw films, completed the examination. Three means of shortening the time of exposure required for young patients are[25]:

1) The use of high-speed film
2) Varying the K.V.P.†
3) Lengthening the time of development of the film.

One of the most practical of these methods is to use high-speed films. The following table lists the approximate time-speed-factor for a number of films:

Relative Speeds of Dental X-ray Films[25]

Time-film-speed-factors	Film-types
1	Kodak Regular‡
4/5	Rinn Universal-BB
1/2	DuPont S
1/2	Kodak-Radia-Tized
1/2	Rinn Intermediate-DC
1/4	DuPont D
1/8	Kodak Ultra-Speed

It can be seen readily that if Kodak Regular film is assigned a time-film speed factor of 1, and this film calls for an exposure of six seconds in the area surveyed by bite-wings, the time of exposure can be halved by using Kodak Radia-tized film (6 seconds × factor of ½ = 3 seconds). To avoid overexposure or underexposure precise technics must be employed with fast films, for they do not have the wide latitude of exposure possessed by films of slower speeds. Kodak Ultra-Speed films may, by the same method, be employed advantageously for very young patients. The time of exposure may be varied by adjusting the voltage.

> "The voltage applied to an x-ray tube determines the penetrating ability of the x-rays produced. Increased voltages generate more penetrating rays, which subsequently produce less contrast in the roentgenogram. Accompanying the increased or decreased penetration is the need for shorter or longer exposures, respectively."[25]

If a time-voltage factor of unity is assigned to the 63 K.V.P. (63,000 volts) setting of the conventional dental x-ray unit,* which operates at 110 volts, the time of exposure can be lengthened or shortened by reducing or increasing the K.V.P. Representative figures are presented which may be used to vary the exposure.

Factors to be Used in Varying the Exposure by Changing the Voltage Applied to the X-ray Tube[25]

Time Voltage Factor†	Voltage Applied to X-ray Tube‡	Corresponding Voltmeter Reading for Ritter Model B X-ray Unit
3/4	70 K.V.P.	120 Volts
1	63 K.V.P.	110 Volts
3/2	55 K.V.P.	100 Volts
5/2	50 K.V.P.	90 Volts

* Film packet size
No: 2 periapical film packet (1¼″ + 1⅝″)
No. 2 bite-wing film packet (1¼″ × 1⅝″)
No. 0 periapical on bite-wing packet (⅞″ × 1⅜″)

† K.V.P. is the abbreviation for kilovolt peak.

‡ Recently, Kodak Regular has been increased in speed so that its present time-film-factor is ½.

* Ritter Model B

† Caution: Time-voltage factors do not apply to the use of intensifying screens in cassettes. For such equipment the factor is higher.

‡ . . . Most dental x-ray units can be changed in this manner. One should consult his x-ray serviceman.

Thus, if the customary bite-wing exposure with Radia-tized film is three seconds when operating at 63 K.V.P., it can be shortened by using a voltage of 70 K.V.P. In this instance the time of exposure is multiplied by a factor of ¾ to give an exposure-time of 2¼ seconds (3 seconds × ¾ factor = 2¼ seconds). Conversely, if more contrast were desired in the radiograph, a voltage of 55 K.V.P. applied to the tube would employ a time-voltage factor of 3/2 and the exposure would be 4½ seconds.

With regard to the amount of exposure which human skin can tolerate:[23]

> "Experiments performed on human skin irradiated with a modern dental x-ray machine indicate that an erythema of the skin of the flexor surface of the forearm can be produced by an exposure of 600 Ma.S.* Such exposure produced an erythema on three out of four patients. The least exposure required to produce an erythema on anyone in these tests was 425 Ma.S. Recognizing that the skin of the face is less sensitive to x-ray radiation than the skin on the flexor surface of the forearm and utilizing this difference in sensitivity as a safety factor, it has been recommended that no single area of the face be exposed at a 7½" target-skin distance to more than 400 Ma.S. in any two week period."

Commercially available fast-developing solutions, which will develop a film in 3½ minutes at 65° F., enable one to reduce the time of exposure by one-quarter if the film is developed for five minutes at the same temperature. If a time-developing factor of one is assigned to the developing time of 3½ minutes, the factor for five minutes would be 3/4. It, therefore, is possible to reduce the exposure of the Radia-tized bite-wing from three seconds to 2¼ seconds (¾ × 3 seconds = 2¼ seconds.)

Factors for Decreasing Exposure Time by Prolonging the Development of Dental Films[25]

Time-Developing Factor	Developing Time at 65° F., minutes
1	3½
¾	5

A technic utilizing an eight-inch target distance at 63 K.V.P. and 10 Ma. will be presented.[22, 24] Such a series routinely will consist of posterior bite-wings, maxillary and mandibular anterior occlusal films, maxillary posterior occlusal films and right and left lateral-jaw films. The time of exposure for this survey, when using Radia-tized intraoral film, is 2½ seconds for children through the age of five, and 3 seconds for children of six years of age and older. In those instances in which they are considered helpful, maxillary and mandibular topographical occlusal films are utilized.

Posterior Bite-wing Surveys

The two sizes of bite-wing film packets generally used to produce radiographs for preschool children are the No. 0 and the No. 2 packets. The dimensions of the latter are the same as those of the regular (No. 2) periapical film packet. Bite-wing film packets may be employed, or commercially prepared. Holders may be obtained which make it possible to use the periapical film packet for the bite-wing surveys.

Both the No. 0 and the No. 2 packets portray the area from the distal portion of the cuspid to the distal of the second primary molar, and provide information about the number of incipient proximal cavities, the thickness of the enamel, the

* Ma.S. is the abbreviation for milliampere-seconds. This index is a measure of the amount of exposure and is the product of the number of milliamperes of current flowing through the tube multiplied by the number of seconds that the x-rays are emitted.[24]

size of pulpal chambers and the extent of pulpal horns, the development of a dentin callous following certain types of partial pulpectomies, and the type of posterior occlusion, if the radiograph is procured while the patient is closed in centric relationship. They also may be used to check the loss of space following premature extractions and the gingival seal and proximal contour of previous fillings as well as the marginal adaptation of cast restorations prior to cementing them in place.

The No. 2 bite-wing will provide additional information about the extent of calcification of the crowns of the permanent teeth, the presence or absence of the crowns of the bicuspids, the condition of areas surrounding root-ends and the resorption of primary roots and the health of the periodontal membrane, lamina dura and periapical bone. (See Figure 1)

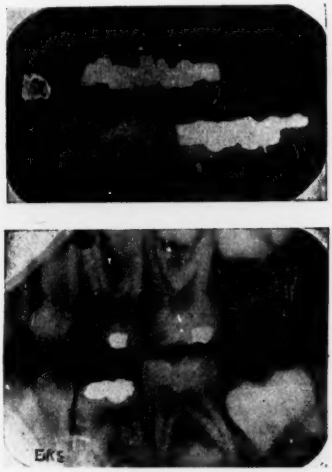


FIG. 1.

No. 0, Posterior (top). Bite-wing Radiograph (Photograph courtesy of K. A. Easlick)
No. 2, Posterior (bottom). Bite-wing Radiograph

Bite-wing surveys are especially useful in determining the relationship of the crowns of the permanent teeth to the roots of the primary teeth because periapical radiographs tend to project the maxillary permanent teeth upon the primary in a manner which permits a false impression of their proximity.[15, 27] The root ends of the primary teeth thus may appear to be prematurely resorbed. The patient is seated comfortably in the dental chair with his head positioned in such a manner that the median sagittal plane is vertical and the ala-tragus line is parallel to the floor. (See Figure 2)

The anterior corners of the film packet should be rounded gently or relieved by finger pressure and the packet placed lingual to the teeth with its anterior

FIG. 2. Position of the Patient in the Dental Chair

FIG. 3. Direction and Point of Entry for the Central Ray When Producing Posterior Bite-wing Radiographs.

border in the cuspid region. It is not necessary to draw the film packet tightly against the teeth, and retention is obtained when the patient bites on the wing or holder of the packet.

The face of the x-ray head is aligned so that it is parallel to the buccal surfaces of the posterior teeth. The vertical angulation should be downward 8° and the central ray directed at the center of the film packet. (See Figure 3)

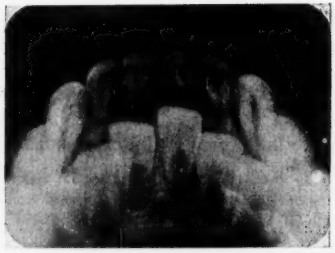


FIG. 5. Mandibular Occlusal Radiograph

OCCLUSAL SURVEYS

The maxillary and mandibular occlusal surveys, using the No. 2 periapical film packet, are invaluable in determining the presence or absence of permanent incisors and indicating the position of the unerupted permanent cuspids. All of the incisor teeth are portrayed on an anterior occlusal radiograph, which is a distinct advantage, because it is not necessary to examine serveral films to gain the needed information regarding this portion of the arch and then rule out the teeth shown in overlapping films. This film also is helpful in evaluating the extent of damage produced by accident to the anterior segments. This damage may involve fractured roots or the inclusion of foreign objects in the tissue. Areas of pathology also are revealed by these surveys, as well as the position of the unerupted teeth. The mandibular anterior occlusal survey accurately portrays the correct root lengths of the incisors.

1. *Maxillary Anterior Occlusal Survey*

The patient's head is positioned in such a manner that the median sagittal plane is vertical and the ala-tragus line is parallel with the floor. (See Figure 4)

The packet is positioned with the sensitive side touching the maxillary teeth and its long axis directed mesio-distally. A small portion of the packet protrudes labially to the central incisors to provide an adequate margin on the radiograph. Retention of the film packet is obtained by the patient biting gently on the packet, with his lips closed during the exposure.

FIG. 4. Maxillary Anterior Occlusal Radiograph.

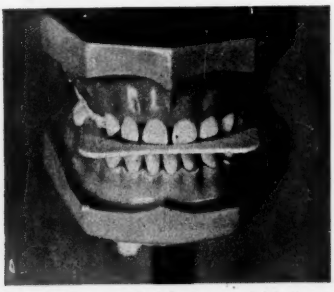


FIG. 6. Proper Positioning and Method of Retaining the Film Packet in the Mouth For Producing the Maxillary Anterior Occlusal Radiograph.

FIG. 7. Direction of the Central Ray Along the Median Sagittal Plane When Producing the Maxillary Anterior Radiograph.

The vertical angluation should be downward 60° with the central ray directed at the apices of the central incisors along the median sagittal plane. The point of entry of the central ray will be about one-half of an inch above the tip of the nose. (See Figures 6, 7)

2. *Mandibular Anterior Occlusal Survey* (*Figure 5*)

The film is placed as for the maxillary occlusal survey, but with the sensitive side contacting the mandibular teeth. (See Figure 8)

The patient's head again is positioned in such a manner that the median sagittal plane is vertical, but his head is tilted back and his chin elevated so that the central ray is directed to form an angle of 60° with the film packet. (See Figure 9).

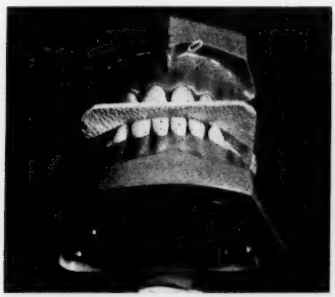


FIG. 8. Proper Positioning and Method of Retaining the Film Packet in the Mouth for Producing the Mandibular Anterior Occlusal Radiograph.

FIG. 9. Direction of the Central Ray Forms a 60° Angle with the Film Packet

3. *Maxillary Posterior Occlusal Survey* (*Figure 10*)

The maxillary posterior occlusal survey will reveal the apices and crowns of the maxillary posterior teeth, a portion of the antrum, and some of the roof of the mouth in the segment where it is taken. Even though the lingual roots of the molars will appear elongated in the radiograph, this survey produces a sufficiently accurate portrayal of dental conditions and is much easier to obtain than the periapical radiographs procured by the usual intraoral technic. The placement of the film especially recommends the application of this method to very young

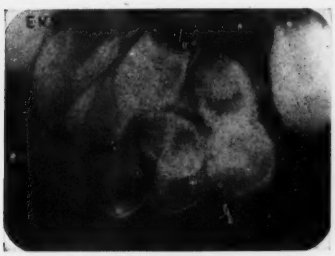


FIG. 10. Maxillary Posterior Occlusal Radiograph

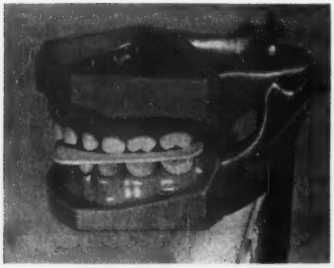


FIG. 11. Proper Positioning and Method of Retaining the Film Packet for Producing the Maxillary Posterior Occlusal Radiograph.

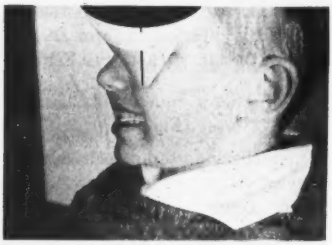


FIG. 12. Direction of the Central Ray for Producing the Maxillary Posterior Occlusal Radiograph

patients, for the film packet is retained when patients place their teeth in the position of occlusal contact.

With the head positioned so that the median sagittal plane is vertical and the ala-tragus line is parallel with the floor, the No. 2 film packet is placed in the mouth with the sensitive side toward the maxillary teeth, and parallel to the occlusal plane. The long axis of the film packet is directed posteriorly, and the anterior border rests parallel to the median anterior portions of the central incisors. Laterally, the packet extends one-quarter of an inch past the buccal surface of the posterior teeth.

The central ray is directed at the apices of the primary molars with a vertical angulation of 60° downward. The central ray should pass between the interproximals of the maxillary primary molars. (See Figures 11, 12)

FIG. 13. Lateral Jaw Radiograph

4. *Lateral Jaw Survey* (*Figure 13*)

The lateral jaw survey may be substituted for bite wings if a young patient will not tolerate intraoral placement of film packets. It is a poor substitute for the bite-wing radiograph in the detection of incipient interproximal cavities, however, lateral jaw surveys will show clearly the root-end environment of the mandibular primary teeth, the amount of calcification, and the sequence of calcification of the permanent teeth. It is useful in determining the occlusal relationships of the opposing dental arches when procured with the patient's teeth in contact. Lateral jaw radiographs should be included in any complete survey of the child's dental arches to appraise accurately the development taking place. This survey has special significance for palliative orthodontic treatment.

The head is positioned so that the median sagittal plane is vertical and the ala-tragus line is horizontal. A 5″ × 7″

film is used in a cardboard holder. The film holder is placed between the patient's head and the pad of the headrest and permitted to rest on his shoulder, being supported along its anterior edge by the patient's hand. To prevent superimposition of the spinal column and the undesired portions of the mandible upon the desired regions of the radiograph, the patient's head is rotated until the tip of the nose is one-quarter of an inch from the film holder, then the chin is raised slightly. The central ray is directed 17° upward and enters at a point one-half of an inch below and behind the angle of jaw on the undesired side of the mandible. The face of the head of the x-ray machine is aligned so that is is parallel with the top edge of the film holder. (See Figure 14).

The exposure may be varied as follows:[22]

No- or non-screen film in cardboard film holder	1¼ seconds
Screen film in cardboard film holder	4 seconds
Screen film in a cassette equipped with "Detail" intensifying screen	1 second

5. *Maxillary and Mandibular Topographical Surveys*

The topographical survey is useful in determining the locations and buccolingual inclinations of the unerupted teeth. It thus becomes a valuable aid in the determination of the path of eruption of the teeth. In addition, it may be used to detect the presence of foreign bodies, the size and position of supernumerary teeth and fractures of the mandible.

Miller[19] was one of the first to recognize that this technic could be used to determine the exact location of unerupted teeth. By directing the central ray in an apico-occlusal direction, through the root canal of the tooth in question, the buccal or lingual position of the tooth may be determined.

a. *Maxillary Topographical Occlusal Survey (Figure 15)*

Super-speed maxillary topographical occlusal film is employed, with a vertical angulation of 80° downward and forward. The exposure is seven seconds.

FIG. 14. Proper Positioning of the Patient and the Film Holder When Producing the Lateral Jaw Radiograph.

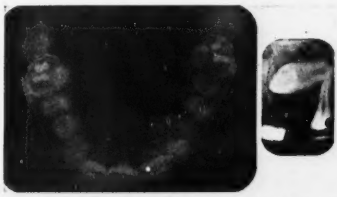


FIG. 15. Maxillary Topographical Occlusal Radiograph

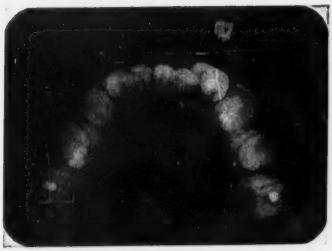


FIG. 16. Mandibular Topographical Occlusal Radiograph

b. *Mandibular Topographical Occlusal Survey (Figure 16)*

Mandibular topographical Radia-tized film is employed, with a vertical angulation perpendicular to the plane of the film packet. The exposure is five seconds.

Discussion and Evaluation of Technics

Optimally, a radiographic survey of preschool children should take little time, require few films, and make use of a simple technic in order that the preschool children may be introduced pleasantly to dental procedures.

Such a survey should demonstrate incipient proximal cavities, and determine the extent of advanced cavities, while showing the morphologic outline and relationship of the pulp and hard tissues. Delayed or advanced resorption of primary roots, root-end environment, and pathology as evidenced by a discontinuity of the lamina dura, the thin white line surrounding the primary roots and permanent crowns, and an alteration in the pattern of adjacent cancellous bone should be distinguishable. As an aid in determining procedures during extractions, the size and proximity of permanent crowns to the roots of primary teeth should be seen. The determination of the degree of calcification, the path of eruption and the sequence of eruption of the permanent crowns may aid in the early detection of a developing malocclusion. Fractured roots, complete intrusion or complete displacement of a tooth from the arch following trauma should be demonstrated clearly, as should certain anomalies of number, shape, position and texture. In addition, such a radiographic survey should be helpful in the preoperative planning of capping the pulp or the partial amputation of the pulp and their postoperative evaluation, and it should aid in the planning of maintainers of the arch length, or other preventive or corrective orthodontic treatment.

Conventional intraoral periapical technics require that a portion of the film packet be in contact with either the incisal edges or the lingual cusps of the teeth, and that the rest of the films be inclined to form an angle with the long axes of the teeth. To achieve less distortion of the radiographic images, modifications of this technic have been introduced. It is difficult to obtain consistently truly adequate radiographic surveys of young children by employing a full mouth series of periapical radiographs, even though supplemented by posterior bite-wings.

Preschool patients frequently will not cooperate in the correct positioning of film packets in their mouths, and the assistance of a person other than the dentist or his assistant is required to hold the packets in position. These attempts frequently may result in distortion of the structures reproduced, in failure to reveal the apices, or the surrounding environment of the primary teeth, or in a failure to extend the survey to the posterior region surrounding the developing second permanent molar.

Such time consuming methods frequently discourage the operator, who then resorts to the use of posterior bite-wings in lieu of a complete radiographic examination. Such a technic does not provide sufficient information for a thorough radiographic aid to the diagnosis of the oral conditions of preschool patients.

A radiographic examination which provides adequate information for aid in diagnosing the oral conditions of these children may be obtained by utilizing posterior bite-wing surveys, maxillary and mandibular occlusal surveys, maxillary posterior occlusal surveys and lateral jaw surveys.

The patient's cooperation is gained readily by the use of this survey since children hold the film packets for the occlusal surveys between their teeth. This positioning of the packet precludes the unpleasant sensations which produce gagging, and the discomfort experienced during periapical placement of the film packet due to pressure on the sensitive oral mucosa. The bite-wing survey, using the No. 0 or No. 2 film packet produces little discomfort, and no unpleasant reactions are occasioned by the use of the lateral jaw survey. This complete radiographic survey is accomplished in a minimal amount of time, and introduces children to dental diagnostic procedures in a pleasant manner.

It would appear, if the literature reveals with any accuracy the trend in dental radiography for preschool children, that the survey which has been described has not received the attention that its merits command.

The practitioner who deals with preschool children must be able to do so in a competent manner if dental procedures for the preschool child are to be as economically rewarding as dental services for adults. The first step in planning treatment must be the gathering of information from which to formulate a diagnosis. Without an adequate radiographic survey such a diagnosis is impossible to obtain. Of more import is the consideration that the child is entitled to a competent appraisal of his immediate need for dental treatment and more than a haphazard guess about his future dental development. A dentist who attempts to practice without obtaining a survey which will do justice to the needs of the patient from a standpoint of treatment and economics justifiably may become conscious of shirking his responsibility to a patient.

The numerous radiographic technics presented in the literature reveal clearly that there is a need for excellent radiographic surveys to aid in the diagnosis of present dental needs and to predict accurately patterns of future dental growth. The technic approved[22], at present, appears to be without equal among those designed for the preschool child. The simplicity of placing film packets and the ease with which cooperation may be elicited from the preschool child will reveal to the operator that with a moderate degree of care the survey may be accurately completed in a relatively short time. Because a complete radiographic aid to diagnosis is obtained, the proper treatment of the child's dental needs may be estimated accurately. Accurate planning results in the saving of time and a fee which is economically feasible for parents, especially those with several children, and the dentist can be rewarded equitably for his services.

It has been estimated that fifty per cent of American children have at least one dental cavity by the age of two years.[2] Studies have shown that bite-wing radiographs are essential to the early detection of interproximal cavities. Clinical examinations (mouth mirror and explorer), unaided by bite-wing radiographs, will fail to detect a large percentage of the interproximal cavities present.[4, 7, 11, 23, 28] Jarvis[13] demonstrated that large, unrestored cavities may cause a significant loss of length in the dental arch.

The detection of normal and abnormal dental development in preschool children is important if adequate operative and preventive orthodontic treatment is to be planned. Virtually every type of dental pathology found in adults may be detected in children. Sweet[30] estimated that twenty per cent of the patients whom he examined had abnormal dental conditions

which were identifiable only by radiographs. Interception of these abnormalities at an early age precludes drastic intervention at a later age.

To obtain adequate radiographic surveys of preschool children, many operators have advocated the use of posterior bite-wings in conjunction with a full mouth series of intraoral and periapical radiographs employing No. 0 and No. 2 size film packets. Occasionally this examination has been supplemented by the use of occlusal or lateral jaw films.

Summary

A simplified technic for a thorough routine survey of the preschool child's oral conditions has been presented. It has been suggested that No. 2 periapical film packets be employed to obtain maxillary and mandibular occlusal surveys and maxillary posterior occlusal surveys, that No. 0 or No. 2 film packets be utilized to procure posterior bite-wing surveys, and that 5″ × 7″ lateral jaw films be secured to complete the examination. Such a survey has been discussed to show its adequacy as an aid to the planning of treatment for both operative and orthodontic procedures. The shortening by three methods of the duration of the time of exposure required to produce radiographs has been discussed. The safely tolerated dosage of x-ray radiation for any single facial area has been presented.

Conclusions

1. An adequate radiographic survey for diagnosing the oral conditions of preschool children may be obtained by the use of maxillary and mandibular occlusal surveys and maxillary posterior occlusal surveys with No. 2 film packets, bite-wing surveys using No. 0 or No. 2 packets to supplement the intraoral surveys, and lateral jaw surveys to complete the examination.

2. The time of exposure necessary to produce a radiograph may be shortened by the use of high speed film, increasing the voltage applied to the x-ray tube, or prolonging the time of developing the film.

3. The safely tolerated exposure to x-ray radiation for any single area of the face at a target-skin distance of 7½ inches is not more than 400 Ma.S. in any two-week period.

Bibliography

1. Allen, C. S. Serial radiodontics in pedodontics. Dent. Radiog. and Photog., **14**: 9–11, 16, No. 2, 1941.
2. American Dental Association, Council on Dental Health. Statement on control of dental caries. Am. Dent. A. J., **34**: 502–4, Apr. 1, 1947.
3. Anderson, G. M. The key to occlusion. Dent. Radiog. and Photog., **4**: 12–3, June, 1931.
4. Barr, J. H. The diagnostic value of radiographic examination for proximal caries in the deciduous posterior teeth. N. Z. Dent. J., **41**: 89–102, July 1945.
5. Bierman, C. W. Radiography in children's dentistry. Dent. Radiog. and Photog., **14**: 5–6, No. 1, 1941.
6. Brown, W. E. The utilization of radiology in a children's practice. N. J. S. Dent. Soc. J., **23**: 17–27, Jan. 1952.
7. Bodmer, Eugene. Diagnosis of dental caries by means of oral (or clinical) and radiographic examination. Northwest. Univ. Dent. School Res. Bul., **39**: 2–6, Apr. 1939.
8. Budowsky, Jack. The x-ray and diagnosis in pedodontia. N. Y. J. Dent., **22**: 330–1, Oct. 1952.
9. Charbeneau, G. T. A bite-wing radiographic study of some problems related to space management in the posterior segments of the primary and mixed dentitions of clinical patients. (Ann Arbor), University of Michigan, 1949. 30 p. typed thesis.
10. Ennis, L. M. Roentgenographic examination of children. N. J. S. Dent. Soc. J., **17**: 4–9, Jan. 1946.
11. Fixott, H. C. Use of roentgen rays in the practice of children's dentistry. Am. Dent. A. J. and Dent. Cosmos, **24**: 91–6, Jan. 1937.
12. Hess, A. F., Lewis, J. M., and Roman, Benjamin. A radiographic study of calcification of the teeth. Dent. Cosmos, **74**: 1053–61, Nov. 1932.
13. Jarvis, Albert. The role of dental caries in space closure in the mixed dentition. Toronto, University of Toronto, 1952. 24 p. typed thesis.
14. Kelsten, L. B. Roentgenograms for the preschool child. N. Y. J. Dent., **21**: 455–8, Dec. 1951.
15. Koch, W. E. Radiodontic service for children. N. J. S. Dent. Soc. J., **16**: 10–2, Jan. 1945.
16. Lo, R. T., and Moyers, R. E. The sequence of eruption of the permanent dentition. Am. J. Orthodont., **39**: 460–7, June 1953.
17. Lozier, Matthew. Periapical roentgenography as applied in children. Oral Surg., Oral Med. and Oral Path., **3**: 58–62, Jan. 1950.

18. MAIN, L. R. The roentgenogram; a guide in children's dentistry. Am. Dent. A. J., **22**: 960-6, June 1935.
19. MILLER, F. C., AND GRISSINGER, C. R. Letters concerning apico occlusal views as a diagnostic aid in determining the exact location of the impacted mandibular third molar. Personal communications, Feb. 16 and 21, 1952.
20. MORGAN, G. E. Roentgenographic studies during childhood. Am. Dent. A. J., **21**: 671-80, Apr. 1934.
21. NANCE, H. N. The limitations of orthodontic treatment. I. Mixed dentition diagnosis and treatment. Am. J. Orthodont. and Oral Surg. (Orthodont. Sect.), **33**: 177-223, Apr. 1947.
22. RICHARDS, A. G. Dental radiography for children. Tenn. S. Dent. A. J., **33**: 268-77, Oct. 1953.
23. ——. The production of erythema of the skin by exposure to x-ray radiation. Personal communication, Nov. 30, 1953.
24. ——. Radiographing the young child. N. J. S. Dent. Soc. J., **23**: 28-30, Jan. 1952.
25. ——. Roentgenographic technics made to order. Am. Dent. A. J., **39**: 396-404, Oct. 1949.
26. ROCKMAN, M. N. Suggestions for radiographing the young child. Ontario Dent. A. J., **28**: 349-50, Sept. 1951.
27. SIMPSON, C. O. Radiodontia in children's dentistry. Am. Dent. A. J. and Dent. Cosmos, **25**: 707-11, May 1938.
28. SMITH, R. K. The x-ray—an essential to diagnosis and prognosis of the child patient. Am. Dent. A. J., **29**: 296-304, May 1942.
29. SWEET, A. P. S. The value of radiodontia in pedodontia. Am. Dent. A. J., **28**: 8-12, Jan. 1941.
30. SWEET, C. A. Radiography in dentistry for children. Dent. Radiog. and Photog., **22**: 1-7, No. 1, 1949.
31. THOMPSON, W. S. Operative radiodontia for the child patient. Am. Dent. A. J., **21**: 2230-7, Dec. 1934.
32. TRITHART, A. H., AND DONNELLY, C. J. A comparative study of proximal cavities found by clinical and roentgenographic examination. Am. Dent. A. J., **49**: 33-7, Jan. 1950.
33. UPDEGRAVE, W. J. Radiodontic technique for the child patient. N. J. S. Dent. Soc. J., **22**: 11-4, Jan. 1951.
34. ——. The role of radiodontics in dentistry for children. N. J. S. Dent. Soc. J., **20**: 9-12, Jan. 1949.

APPLICATION FOR TABLE CLINIC

1955 MEETING—SAN FRANCISCO—OCTOBER 15-16

Name:

Address:

Title of Clinic:

Space required:

Equipment needed:

Send this application to Irwin Beechen, 2832 Summit, Oakland, Calif.

LET'S GO TO SAN FRANCISCO

Get ready for the trip to San Francisco for the national A.D.A. and A.S.D.C. meetings in October. Be ready for San Francisco's temperate, yet invigorating climate. October is Indian Summer in San Francisco, one of the nicest times of the year.

There is much to see, much to do, in this fascinating metropolis. Here are a few of the things you should not miss:

Swing aboard one of the famous cable cars and ride high up the hills for beautiful panoramic views of the city. Observe the many colorful sidewalk flower stands filled with flowers of every description and color the year round.

During a lapse in the convention session you may want to walk through Chinatown with its many pagodas and joss houses. Take your wife and friends to one of the outstanding Chinese restaurants for food exotic and delicious. San Francisco's Chinatown is the largest Chinese settlement outside the Orient. A special escorted tour through Chinatown's narrow streets and alleys can be arranged.

Don't miss Fisherman's Wharf—a bit of Naples to the eye, a bit of heaven to your nostrils if you love fresh seafood. Great cauldrons cooking crab on the sidewalks outside the many interesting fish grottos. Observe the hundreds of fishing boats at this famous harbor while enjoying sea-food supreme in one of the many restaurants.

You shouldn't leave San Francisco without a visit to the Golden Gate Park whose thousand acres are a paradise reclaimed from the sand dunes. A beauty spot of the world—a garden of drives, lakes, and groves. Here also are such attractions as the DeYoung Museum, Steinhard Aquarium, Academy of Sciences, the Oriental Tea Garden and the Planetarium. Fleischhacker Pool (largest outdoor swimming pool in the world) and the Zoo are a short drive away.

One of the most fascinating of tours is the boat trip around San Francisco Bay. All of the Bay communities are included in this tour pointing out the points of interest including The University of California, the San Francisco Bay Bridge, the Golden Gate Bridge, and Alcatraz island.

Fine food is traditional in this city. Every nation is represented. One may truly "eat around the world in San Francisco", French, Italian, Swedish smorgasbord, German, Russian, Spanish, Chinese, and Japanese. You will have to discover the restaurants that please your palate most. One of your fondest memories of San Francisco will be its marvelous cuisine.

Let's Go to San Francisco!

Unit News

Massachusetts

The first meeting of 1955 was held at the Forsyth Dental Infirmary on January 26. The speaker was Harold Berk whose subject was "The Treatment of Pulp Involved Teeth."

The officers for the year are as follows:

Paul Sydow.....President
Frederick Shiere.....Vice President
Egil Klinkenberg.....Sec'y-Treasurer

After the presentation of the lecture Dr. Berk was awarded a plaque for his untiring efforts and work for the unit.

Northern California

The California Dental Society sponsored two simultaneous meetings in the San Francisco Bay Area to commemorate the 7th Annual Children's Dental Health Conference. A meeting for the dental profession was held at the St. Francis Hotel in San Francisco. This meeting consisted of a concentrated one day seminar in Pedodontics including operative procedures and office technics. Essays were presented by Irwin Beechen, Walt Mandler, and Bernard Dietz.

Simultaneously a meeting in Berkely, California was presented by the dental profession for health educators and other interested lay groups of California. It was aimed at providing better dental health for the children of the state by stimulating among those attending the desire to work toward a dental health education goal on a year-round basis. Among the able speakers were dentists, physicians, superintendents of schools in the Bay Area, professors of public health, and P.T.A. representatives. Work shops were organized in the afternoon sessions to formulate concrete plans for the presentation of a dental health education program to the public in the State of California in 1955.

Among those on the program committee were Kent Kohler, Haywood Norton, Lloyd Richards, John Parker and Don Laston.

Dr. Charles Sweet, Sr. has returned to the College of Physicians and Surgeons for presentation of his post-graduate courses in Dentistry for Children through the courtesy of the public health department of the Oakland public schools where he is the director of dental health education. His next course at the Dental School will be in June of this year.

Arkansas

The Program for the April Meeting which was held in conjunction with the Arkansas State Dental Convention was as follows:

Sunday April 3, 5:00—Executive Council Meeting

Monday April 4, 8:00—Breakfast Business Meeting

Tuesday April 5, 11:00—Program; Dr. Robert L. Henry" Children's Dentistry from the Pediatrician's Viewpoint"

Tuesday April 5, 2:00—Dr. Ralph Ireland, Sect. American Board of Pedodontics

Wednesday April 6, 9:00–11:00—Table Clinics

Children's Dental Health Day was actively promoted by members of the Arkansas Unit working on Local Society Committees.

Excellent coverage through radio forums, television interviews, puppet shows and newspaper coverage throughout the week of Feb. 7–13 spotlighted our "Operation Bitewing Project" of free dental radiographs to school children in the fall.

Dr. Kenneth Lawrence of Kansas City, Mo. was the speaker for the Central District Dental Society, Jan. 19.

New York

It has been announced by Dr. Robert Fisher, President, that local study groups for intensive exploration of problems in Dentistry for Children of interest to general practitioners, are being planned by the Metropolitan Unit of the New York State Society of Dentistry for Children. These groups to be active in various sections of the city, will supplement the regular functions of the Unit: the latter work consists of scientific meeting and the participation of members in community dental health projects, research, teaching, educational talks, and presentation of clinics on numerous aspects of pedodontics.

This year the Metropolitan Unit has taken part in community projects aimed to improve the dental health of the community. During the past few months members of the Unit have taken refresher courses in speaking in order to give talks on fluoridation at dental meetings and before adult groups. They have also been working with the Welfare and Health Council and other community groups to spread the message of water fluoridation. Members have helped to plan workshops on dental health, have given clinics at the meeting of the American Dental Association and the Cuban Dental Association, and have shared in scientific sessions of other groups throughout the city, state and nation. Members have engaged in programs for improving the dental health of handicapped children such as those suffering from cerebral palsy or mental retardation. Several members are engaged in research on ultrasonics and others are carrying on investigations on special pedodontic problems.

Those who wish to join the Metropolitan Unit or to register for the proposed local study groups, are urged to get in touch with the undersigned. Suggestions for topics to be taken up by the study groups will also be welcomed.

M. Joel Freedman, Secretary
300 West 23rd Street, New York

New Jersey

The New Jersey Society of Dentistry for Children held its annual Mid-Winter meeting on Wednesday, January 12, 1955 at the Jersey City Medical Center. In the afternoon, table clinics were presented by staff members of the Murry and Leonie Guggenheim Dental Clinic for children in New York, under the direction of Dr. Daniel F. Tobin, and by members of the Pedodontic staff of the New York School of Dentistry.

Dinner was served at the Hotel Plaza in Jersey City with Dr. Walter C. McBride of Detroit, Michigan as guest speaker. Dr. McBride's topic for the evening was "Something better for the Kids". In his presentation, Dr. McBride outlined office equipment and procedures suitable in performing dentistry for children.

Officers of the New Jersey Unit are:
Dr. Albert W. Theurer, President—
123 Chestnut Street, Roselle, N. J.
Dr. Saul M. Gale, Vice President—
425 Clinton Place, Newark, N. J.

Dr. Fancis Lehr, President-Elect—1139 East Jersey Street, Elizabeth, N. J.

Dr. Robert D. Moyer, Secretary-Treasurer—144 So. Harrison Street, East Orange, N. J.

Oklahoma

The Oklahoma A.S.D.C. group met in Tulsa, Okla. in conjunction with the state meeting on April 18th. A resolution to assist the various state districts in conducting the "Smile Contest" on a state-wide basis was adopted.

Officers for the coming year are—

Pres.—C. A. Sebert, Clinton, Okla.

Vice-Pres. Harold Pollack, Okla. City

Sec'y-Treas. W. E. Hopkins, Okla. City

Northern California

Following are the Northern California State Unit officers for 1955–1956:

President—Carl H. Ellertson, 319 Homer Ave., Palo Alto

Vice-Pres.—Hayward Norton, 2434 Haste St., Berkeley

Pres. Elect.—Edward S. Mack, Stonestown Bldg., 595 Buckingham Way, San Francisco

Sec'y-Treas.—Lloyd F. Richards, 760 Market St., San Francisco

Rhode Island

Following are the new officers for the Rhode Island State Unit:

President—Dr. Albert S. Goodman, 3202 Post Road, Apponaug, Rhode Island

Vice-Pres.—Dr. Richard E. Deutch, 505 Union Trust Bldg., Providence, Rhode Island

Sec'y-Treas.—Dr. Roger H. Brown, 868 Reservoir Avenue, Cranston 10, Rhode Island

Kentucky

Following are the Kentucky State Unit Officers for 1955–1956:

President—Dr. Arthur M. Mickler, 1974 A. Douglas Blvd., Louisville, Kentucky

Vice-President—Dr. John Jennison, 31 N. Main Street, Kroger Bldg., Madisonville, Kentucky

Secretary-Treasurer—Dr. Edward B. Gernert, 1023 W. Indian Trail, Louisville, Kentucky

Michigan

The Michigan Unit of the A.S.D.C. has been very active in the recent spring months.

The March meeting was held in Ann Arbor. The speaker, Dr. Laurie C. Dickson, Chief of Psychosomatic Medicine at the Henry Ford Hospital in Detroit, discussed "The Psychosomatic Aspects of Dentistry for Children." The lecture must have indeed been very stimulating as a lively discussion period followed.

In April, at the Michigan State Dental Meeting, M.S.D.C. held its annual luncheon meeting. Elections for the coming year were in order and the following officers will preside.

Hugh M. Kopel—Pres.

Joseph Cabot—Vice Pres. (Military leave of absence)

George Guest—Sec'ty-Treas.

Our guest speaker at the luncheon was Dr. Wilf Feasby of Hamilton, Ontario, a council member of the Canadian Society of Dentistry for Children. Dr. Feasby spoke about the organization and work of the Canadian society.

In May, M.S.D.C. again sponsored its annual Practice Management Panel for the graduating seniors of the University of Detroit and University of Michigan Dental Schools. This very popular meeting was introduced some five years ago by Dr. Al Seyler who has been its very apt moderator for these years. Following brief talks by the members of the panel, the seniors are encouraged to ask about

any problems they might have concerning their future dental practices.

Indiana

The Indiana Unit, in cooperation with the Indiana University School of Dentistry and Indiana Cancer Society, presented a symposium "Oral Tumors in Children" on April 20, 1955. The program was as follows:

Morning Session: "Neoplastic Lesions"

9:30 a.m.—"Aberrations in Tooth Development"—Isaac Schour, D.D.S., Chicago, Ill.

10:30 a.m.—"Sarcomas of the Head and Neck in Children"—Frank Vellios, M.D., Indianapolis, Ind.

11:00 a.m.—"Odontogenic Tumors in Children"—William G. Shafer, D.D.S., Indianapolis, Ind.

11:30 a.m.—"Leukemia in Children and Its Oral Manifestations"—Edward Smith, M.D., Indianapolis, Ind.

12:15 p.m.—LUNCHEON—Indiana Student Union and Food Service Building

Afternoon Session: "Inflammatory Lesions Resembling Tumors"

1:30 p.m.—"Viral Stomatitis in Children"—Maury Massler, D.D.S., Chicago, Ill.

2:30 p.m.—"Fibrous Dysplasia of the Jaws in Children"—Ralph E. McDonald, D.D.S., Indianapolis, Ind.

3:30 p.m.—"The Peripheral Giant Cell Tumor in Children"—Richard Phillips, D.D.S., Indianapolis, Ind.

3:30 p.m.—Summary—William G. Shafer, D.D.S.

Ohio

State Unit officers for this group for 1955 are as follows:

President—Mitchell S. Goodman, Columbus.

Vice-President—Hal Barlow, Akron.

Sec'y-Treasurer—Finn L'Orange, Cleveland.

Washington, D. C.

As part of a statistical study on the effects of fluoridation, free dental examinations were given in Washington, D. C., recently to some 1,500 preschool children. The project was sponsored by the District Unit of the American Society of Dentistry for Children. The three- to five-year-olds attend the District Recreation Department's 45 cooperative play groups in public school and community center facilities.

Hawaii

Although far distant, our Hawaii Unit is one of the most active components of the A.S.D.C. It holds regular and well attended meetings with good speakers, ofttimes from the mainland, and it conducts an outstanding dental and public relations program.

Officers of the Hawaii Unit are:

President—Dr. Arthur Chun-Hoon

Vice-President—Dr. John E. Knight

Secretary-Treasurer—Dr. Ralph N. Akamine

Dr. B. A. Sherman, Publicity Chairman, has sent us the following information about his Unit's activities:

"On February 8th during National Children's Dental Health Week, the Hawaii Society of Dentistry for Children, an affiliate of the American Society of Dentistry for Children, sponsored at the Strong Carter Dental Clinic, Honolulu, Hawaii a clinical program for the Honolulu County Dental Society.

The clinicians and their presentations were Drs. Warren and Harold Itokazu, Therapeutic Pulpotomy; Dr. George

Hennessy, Rubber Dam Application and Class 2 Amalgam Restoration; Dr. Manuel Kau, Banded Amalgam Crown; Dr. Richard Dinham, Simplified x-ray Technique; Drs. Clarence Okamoto and K. L. Young, Stainless Steel Crown; Dr. Robert Gibson, x-ray Interpretations; Dr. Edwin Akamine, Sodium Fluoride Therapy.

A dental health workshop was put on by members of the society and aided by dental hygienists and dental assistants. It consisted mainly of posters, charts, models, photographs, x-ray film, and printed material which were explained to the audience by members of the society.

Articles on "Better Dental Health for Your Children" have been appearing in one of our daily newspapers, "The Honolulu Advertiser". These articles were obtained from the American Dental Association."

The program for the workshop mentioned above, was as follows, and was presented to the Hawaii Congress of Parents and Teachers:

Theme: Prevention—"The Key To Dental Health"

I. *What the Community Can Do*
   Fluoridation:
   - A. Benefits and safety
   - B. Fluoridated water for sampling

II. *What the Parents and Teachers Can Do*
   - A. Proper use of toothbrush
   - B. Diet and nutrition
   - C. DPI dental examination chart

III. *What the Dentist Can Do*
   Preventive Dentistry:
   - A. Periodic check-up
   - B. Dental x-rays in diagnosis
   - C. Sodium fluoride applications

   Restorative Dentistry:
   - A. Correct cavity preparation
   - B. Preservation of primary teeth with infected pulps
   - C. Restoration of lost chewing surfaces

   Orthodontics:
   - A. Preventive
   - B. Corrective

IV. *Educational Aids*
   - A. Display of dental health educational material
   - B. Audio-visual aids

"Material for Unit News should reach Mel Noonan, 630 N. Woodward Ave., Birmingham, Michigan, before October 1, December 15, 1955, March 15 and July 1, 1956 for inclusion in the Journal. Give your Unit some publicity!"

A Stainless Steel Spur-type Space Maintainer

JACK CALVERT, B.A., D.D.S.

Perhaps no problem of dentistry for children has been felt more acutely by the conscientious practitioner than the mesial drift of the unerupted first permanent molar following the premature loss of the second primary molar.

The value of this appliance has been recognized for many years and has been recently pointed up by the data presented by Dr. Kronfeld in the Journal of Dentistry for Children, 1st quarter, 1953, in which he states that 70% of all second primary molars lost prematurely were followed by mesial drift of the first permanent molars with a resultant malocclusion.

The spur type maintainer discussed here is not a new innovation in dentistry for children. However, until the advent of the stainless steel crown, fabrication of this appliance was costly and tedious, involving many steps, among which were meticulous impression taking, casting of small, thin gold crowns and of course, the high fee necessary.

Now, with a great assortment of stainless steel crowns available at a very modest cost, this service is available to every child in its need. Two techniques for handling this problem will be presented in this article, an indirect and a direct method.

INDIRECT SPUR-TYPE MAINTAINER

After determining from adequate clinical and roentgenographic examination that a second primary molar must be extracted prior to the eruption of the first permanent molar, the first primary molar in the same quadrant is prepared for the reception of a stainless steel crown, making sure of good gingival contour and adaptation and positive seating of the crown in occlusal harmony with the adjacent and opposing teeth. All decay must be eliminated and bases placed. With the crown in place, an alginate impression is taken, the crown removed, and the patient dismissed (Fig. 1). If the operator desires, a shallow occlusal impression may be taken of the opposing arch for occluding the spur.

Carefully holding the crown in place in the impression, vibrate a good stone model (Fig. 2). After the model is dry, cut a groove mesio-distally along the occlusal sulcus of the second primary molar tooth to be extracted as a guide for the spur. Then, working with the x-ray film, bore a hole in the model in the location of the distal root of the second primary molar, using a 559 or 560 bur. (Fig. 3). Adapt the spur so that its tip will rest just mesial to the mesial surface of the unerupted first permanent molar and extend to approximately the contact area of that surface. This is really much easier than it sounds for a good x-ray makes this step very simple.

After the spur tip is placed, contour the crown end of the spur through the groove and around the lingual surface of the crown at about the junction of the middle and occlusal thirds of the crown. (Fig. 4). Solder firmly. Either flame or electric process prove adequate. The type

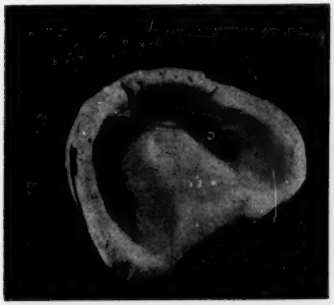


FIG. 1. Impression with stainless steel crown removed from prepared first primary molar and ready for pouring stone working model.

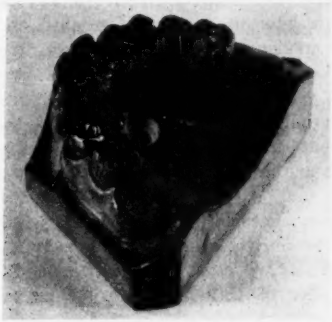


FIG. 2. Stone working model with stainless steel crown in place.

FIG. 3. Groove and distal root hole out in working model.

FIG. 4. Spur in place ready for soldering.

FIG. 5. Appliance soldered and in place just after extraction. First permanent molar is uncovered on acrylic model showing relative placement of spur.

FIG. 6. Roentgenogram showing correct mesio-distal and gingival placement of the polished steel spur tip.

of solder this operator finds best is the type sold by the Rocky Mountain Metals Co. of Denver, although any chrome alloy solder should do as well.

The appliance may now be removed from the cast, polished, and the patient recalled.

After adequate anesthesia, the second primary molar is removed and the appliance slipped into place, (Fig. 5) making sure that the spur does not bind on the sides of the socket of the distal root. The bite should be checked and a check x-ray taken to determine the absolute position of the spur tip in relation to the first permanent molar. (Fig. 6). In the few minutes taken for developing the film, most of the hemorrhage will be controlled. After minor adjustments of the spur, the area is sponged dry, the clinical crown of the first primary molar is sterilized and the appliance permanently seated. Care should be taken that surplus cement does not enter the extraction socket. Healing is ordinarily uneventful and the gingival tissue adapts well to the polished steel spur.

Direct Method

Here, extraction, fabrication of the appliance and the permanent seating are all done at one time. After a little practice, this method works better in a busy pedodontic schedule than does the more time-consuming indirect method. Usually no more than three quarters of an hour need be reserved for the entire procedure.

After adequate block anesthesia, the second primary molar is extracted and the first primary molar is prepared for the stainless steel crown. Any pulp capping or pulpotomy is done at this time, and bases placed. After the crown is properly festooned and fitted, a short length of .040 stainless steel wire is soldered to the lingual surface of the crown as described for the indirect method. When approximate fit has been achieved, the appliance is placed and a quick check bite and x-ray is taken. After minor adjustments have been made, the appliance is polished and sterilized, and set permanently.

An alternate to this direct technique may sometimes be used if the first primary molar is free of decay or not too seriously involved so that anesthesia for its preparation is not necessary. On the first appointment (usually an emergency) the second primary molar is extracted and the patient dismissed. Between 48 and 96 hours later the patient is recalled and the appliance fit and placed direct. The socket in this interval is still well open but yet does not seem to be sensitive, especially if a few drops of any of the potent topical anesthetics are teased into and around the clot before inserting the spur. An added advantage of this two-appointment, direct method is that the hemorrhage problem is eliminated.

When we stop to reflect upon the number of little folks we see in our offices each year who must lose second

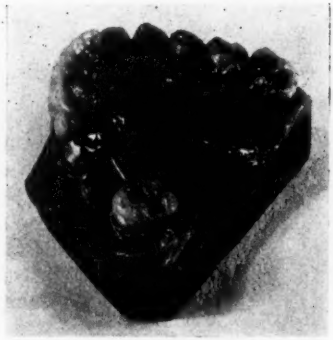


Fig. 7. Appliance after spur has been cut off to serve as bumper type maintainer after full eruption of first permanent molar.

primary molars two, three or more years prior to the eruption of the first permanent molars and when we realize that the space that tooth held will not be occupied by the second bicuspid until after the child is ten or older, this appliance surely seems worthy of some consideration in a progressive and serving practice.

We know that statistic-wise, at least, 70% of these cases will require an orthodontic correction after the first permanent molars erupt but with this appliance in place it is a simple matter to clip or disc off the imbedded spur and remove the tissue end after the first permanent molar has erupted, allowing the cut spur end to contact the mesial of the molar and still maintain the bicuspid space. (Fig. 7). Thus we see that this simple appliance will in many cases give from six to nine years of good service, acting not only as an adequate space maintainer but also as a restoration for the first primary molar and giving it a very reasonable assurance against recurrent decay.

Certainly some precautions should be taken before this appliance is placed. First, the parents should be consulted and the purpose of the maintainer explained. It is sometimes a bit disconcerting for father to peek up over his evening paper and see junior proudly displaying a piece of wire projecting from the depths of his mandible. Also, the tolerance of tissue for stainless steel should be explained, for, at least in this practice, I find many parents who have only heard of the restoration, and who have preconceived ideas about it rusting, or growing fast to the bone, and many other notions.

And last but not least, the parent should be apprised of the fee before the appliance is placed. In this office the fee covers the conversion of the spur appliance to the bumper type when the first permanent molar has erupted to full occlusion and any other checks or adjustments and observations the operator might find necessary.

707 Union Arcade
Davenport, Iowa.

NOTICE

In "Changing Times" magazine for June 1955, there appeared a nicely written article "Straightening Kids Teeth", intended for lay reading. Robert Luce, Associate Editor, advises me that reprints are still available. Upon request a sample copy and quantity prices will be sent. Just mention the Journal of Dentistry for Children and address "Changing Times", 1728 H. Street, N. W., Washington 6, D. C. A.E.S.

Behavior Control by Suggestion

S. Irwin Shaw, D.M.D., M.Ed.

Introduction

Within recent years the dental profession has become acquainted with the use of hypnosis in the practice of dentistry under the names of Hypnodontia, Psychosomatic Sleep in Dentistry, and Dental Psychosomatics. Dental magazines and publications point to the number of dentists making use of hypnotic phenomena to help their patients overcome fears and phobias connected with dentistry. These practitioners are organized into groups for research in the subject as related to dentistry, or belong to societies for general research in clinical and experimental hypnosis. Such groups are located in all parts of the United States and are organized as Hypnotic Study Clubs, as the American Society of Psychosomatic Dentistry, and under the American Society for Advancement of Hypnodontics. Many of these dentists also belong to the Society for Clinical and Experimental Hypnosis whose membership includes psychologists, physicians, dentists, and members of allied scientific disciplines.

In spite of its acknowledged scientific basis, hypnosis remains a question to the greater part of the dental profession, and its full acceptance has been delayed. For those unfamiliar with the advantages and disadvantages of hypnotic sleep in the dental chair it is hoped that this paper will be enlightening in some degree, and for those who feel that our modern methods of practice can suffice without the sleep state of hypnosis, the use of waking suggestion is offered.

Hypnosis is recognized as a state of hypersuggestibility in which the patient appears to be asleep but is actually deeply relaxed in a condition resembling 'day-dreaming'. In this state all suggestions agreeable to the subject's conscience are accepted and can influence his autonomic nervous system to accelerate or inhibit bodily activities through its sympathetic or parasympathetic divisions. Various phenomena helpful to the patient and the dentist can be obtained by this response.

A better understanding on the part of dentists will show that the principles of suggestion are essential to dental practice at all times, whether we use the hypnotic sleep state or not. We become aware of the extreme value of hypnosis in *special* dental cases,[20] and we recognize that the waking application of suggestion is of value with *every* dental patient.

Hull[10] in 1933 maintained that practically all the phenomena obtained in the sleep state of hypnosis could be duplicated in the waking state, and Weitzenhoffer[26] today offers further enlightenment on the laws and properties of suggestibility related to both waking and sleep states. LeCron and Bordeaux[12] considered that anything which influenced the thought and action of an individual by suggestion might be termed hypnosis, in which case waking response becomes a preliminary stage in the various degrees of hypnotic response.

The percentage of patients 'put to sleep' by dentists using hypnosis varies with each practitioner, but it is never a one hundred percent practice. Burgess[5] says, "At least fifty percent can be hypnotized sufficiently for painless dental opera-

tions." Nevertheless these dentists benefit *all* their patients through the unconscious application of positive suggestion in the two-way flow of interpersonal feeling between patient and dentist. The patients not in hypnotic sleep learn to relax in the dental chair through this direct and indirect approach, and become co-operative in every way.

In considering the state of hypersuggestibility connected with hypnosis, it is not known whether it results from a conditioning of the suggestibility latent within us in varying degrees at birth, (childhood learning and imitation is a reaction to direct and indirect suggestion) to produce response whenever stimulated by hetero-suggestion (given by another person); whether the suggestibility is directly connected with early life relationship to parents and parental influence; or whether hetero-suggestion of suitable adaptation to the specific personality of the individual, awakens an original response which in turn stimulates the mechanisms of auto-suggestion to develop the hypersuggestibility peculiar to hypnosis.

Regardless of these unconscious mechanisms it is generally recognized that suggestion response in the sleep state of hypnosis and that in the waking state differ only in degree, the responses being measured by the type of phenomena found in each stage. In the various scales given for classification of the depth of response in hypnosis, 'waking response' might precede the very lightest 'sleep state' classified according to Davis and Husband[7] as 'Hypnoidal', with symptoms of, "Relaxation, fluttering eyelids, closing of eyes, and complete physical relaxation". The symptoms in waking response are similar excepting for fluttering eyelids and eye closure, and, as is the case with other stages of hypnotic response, this waking response lends itself to further conditioning with each subsequent visit. The patient relaxes himself more and more, and at the same time raises his pain threshold in the waking state to where he can easily tolerate all the minor discomforts in the dental chair, and he becomes an agreeable co-operative patient.

Practice in the use of suggestion to the child dental patient in the waking state makes us aware of the possible effect of indirect suggestion and of negative suggestion. The dentist can understand that his patient may have acquired a negative attitude towards dentistry through unfavorable suggestion during contact with other patients or other dentists. He begins to see how his own voice, or his assistant's voice over the telephone can suggest a cold impersonal acceptance or a warm sympathetic welcome. He can also realize that some patients could be sensitive enough to be influenced by suggestion indirectly reflected by the interior decoration of his reception room, or the color of its walls as mentioned by Bordeaux.[3] Along psychological lines the dentist might consider the possibility of a patient acquiring a negative attitude in relation to dentistry through father identification with the first dentist seen in early life, where the dentist as an individual is indirectly suggested to the child either consciously or unconsciously as a disliked father figure. Along the same lines the Freudian 'pleasure-pain' consideration produces the possibility that some child problem-patient might be the result of regression and the instinctual need to protect the erotogenic oral zone.[22]

In short, the study of suggestion applied to the child or adult dental patient leads us to take into consideration the *whole* individual and his *total personality* in relation to everything connected with the dentist as an individual as well as a repre-

sentative of the dental profession. Along with this we learn to include the fact that each and every individual is being constantly influenced by suggestion directly and indirectly, with every stimulus that is registered through any one of the five senses, and that our behavior is affected by these stimuli. A full understanding of this enables us to approach our patients with a positive attitude that will reflect and indirectly suggest consideration and sympathy to the apprehensive individual.

While presenting the value of waking suggestion, it is hoped the dental profession will recognize the need for using the sleep state of hypnosis in those special dental cases where a greater degree of response is essential, or where a patient is not amenable to waking suggestion at the hands of the general practitioner, and also for prevention of some of the psychosomatic dental conditions covered in Landa's book[11] on psychosomatic dentistry.

It should be kept in mind that with the ordinary application of hypnotic sleep to the dental patient without regard to the dynamics involved, his fears are quickly suppressed, whereas waking suggestion only allows for his fears to be gradually neutralized. This reaction in the waking state is referred to as a de-conditioning process by Ryan,[17] and in this de-conditioning the necessary relaxation and cooperation develops in direct relation to the speed with which rapport between dentist and patient is established. In hypnosis, rapport is already established when the patient responds and accepts the suggestion to sleep by going into any one of the classified sleep states.

Where the circumstances require it, as with individuals who call for extraordinary consideration for some reason or other, the dentist might refer his patient to a specialist in hypnosis. Under hypnotic treatment by the specialist the patient could be conditioned to respond to the waking suggestions of his own dentist. The general practitioner versed in the application of waking suggestion would then be in a position to complete the necessary dental work to the full satisfaction of the patient and without loss of time at the dental chair.

While serving to allow for comparison between suggestion in the sleep state and that in the waking state, this paper also aims to stress the need for instruction in applied psychology to the dental student. Such knowledge used by the student in his senior year while at work on patients in the college clinic, would enable him to graduate on a much higher professional level than the mechanically-minded dentist of the past. The public, in recognition of our efforts to be of greater service, would then increasingly respect the profession and hold us in higher esteem and with less fear.

Hypnosis in Dentistry

The medical profession pioneered suggestion therapy when Mesmer of Vienna in 1776 introduced 'Animal Magnetism' in explanation of the phenomena associated with his method of treatment. Braid, (1843) an English surgeon, recognized that suggestion rather than magnetism was involved. He named the response Hypnotism because it resembled the normal sleep state. Later in France, Liebeault and Bernheim made use of hypnosis to treat every ailment that presented itself at their clinic in Nancy, where they taught that suggestion was an essential to hypnotic response.

However, the medical profession and the dental profession were both slow to accept the use of hypnosis in the treatment of patient needs. Jean Etienne Oudet of Paris was the first to demonstrate that hypnosis could be of value to

the dental profession. In 1837, when induced anesthesia was still attributed to Mesmer's magnetism, Oudet reported the first painless extraction of a tooth, and from that time on, a few dentists here and there in various parts of the world have used the hypnotic sleep state to relieve fear and pain in their practice of dentistry. A stigma of mysticism and occultism was introduced when mesmerism, and later hypnotism, was adopted by theatrical entertainers. These men with magical claims and sensational practices made hypnosis objectionable in the eyes of the healing professions, and the public too became fearful of its use.

World Wars I and II brought recognition when hypnosis proved its worth in the psychotherapy wards of American and British army hospitals. Following World War I, Hull[10] and his research in the psychology laboratory at Yale University raised hypnosis to a scientific level, and since World War II the medical world has made continuous use of hypnotherapy wherever applicable. Numerous books and articles have been written on the subject in recent years by psychologists, physicians, and dentists, and the Society for Clinical and Experimental Hypnosis publishes an outstanding coverage of everything related to the use of hypnosis in its quarterly Journal.

In dentistry, men like Ament,[1] Marcus,[14] Samet,[19], and Wookey[27] have made literary contributions on the use of hypnosis, and Guze[8] in the Annual Review of Literature on Hypnosis (1953) lists Moss,[16] Shaw,[21] Stolzenberg,[24] and Weinstein,[25] among other dentists in the United States whose writings in dental literature emphasized the psychological factors pertaining to the application of hypnosis to dentistry. Burgess,[5] and Heron,[9] psychologists also interested in its dental use, have written books and articles besides conducting courses of instruction in the use of hypnosis to various groups of dentists throughout the country.

Most of the above writers have reported on the advantages and disadvantages of using hypnotic sleep at the dental chair, and all are agreed that the advantages outweigh the objections. In general, the complaints given are:

1. The amount of time required for the initial induction of the sleep state in patients who are agreeable to using hypnosis.
2. The uncertainty of response as compared with the ready availability of general and local anesthesia.
3. The necessity for extensive training in the techniques of induction, plus a knowledge of psychology.
4. The need to overcome personal prejudice on the part of some patients.

Some advantages are:

1. It helps remove all fears related to the dentist and his work.
2. Anesthesia may be developed by suggestion, for use in operative work and for oral surgery, where other anesthetics are contra-indicated.
3. Post-operative shock can be eliminated and the patient made more comfortable after surgery.
4. Relief of gagging, bruxism, and trismus.
5. Tolerance for new dentures during breaking-in period.

The above are but a few of the advantages that can be obtained for the patient through the use of suggestion in the sleep state of hypnosis, and the reader is referred to the book written by Moss[16] for a thorough and detailed coverage of hypnodontia, including a full comparison of all the pros and cons related to its use.

Hypnotic sleep can be induced at the chair by a number of techniques, all aimed at reducing the patient's sensory

intake and motor output, so that the subject's field of awareness is brought to the point where it coincides with his focus of attention on the verbal suggestions being given. In this condition the physical inactivity of the patient allows for acceptance of suggestions to relax, and with an established rapport between dentist and patient, the latter agreeably *puts himself* into the desired "sleep" at the suggestion of the operator.

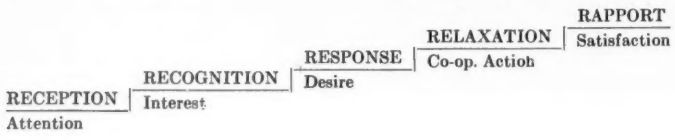
Every technique calls for an initial "mind set" to help develop the necessary rapport and prepare the patient for acceptance of suggestion and the particular method of its application. Even the theatrical entertainer's success hinges on a favorable "mind set", regardless of appearances. In the theatrical environment the prestige of the showman and the publicity given his performance by advance advertising, produce this required frame of mind in many individuals within the audience by auto-suggestion or self suggestion, and most of those who answer the call for volunteers readily respond to the entertainer's command to 'sleep'. For the development of the "mind set" in the dental office and a detailed description of the various methods for sleep induction, the reader is again referred to Moss, Chapter X.[16]

Waking Suggestion in Dentistry

Because of the disadvantages given above, many dentists are unwilling to use hypnotic sleep in their practice. For these, waking suggestion used in conjunction with the full armamentarium for pain control available to the dentist, is herewith presented.

Waking suggestion is not to be confused with Brenman and Gill's waking hypnosis[4] which is a stage of hypnosis induced without the subject's awareness of his being hypnotized, and he responds in every way without resorting to the sleep state. In waking suggestion we recognize that the emotional state of the apprehensive dental patient is a result of past conditioning through direct and indirect unfavorable suggestion, and that he now requires *satisfactory experiences with his own dentist* in order to be de-conditioned. By our manner of approach the patient is subjected to direct and indirect positive suggestion with a view to developing his sense of awareness to a keen understanding of a sympathetic dentist and his favorable intentions. The resulting satisfactory experiences have a positive effect on the negative-minded fearful patient, and eventually there is established a warm feeling of confidence towards the operator. The regard and faith which follows is known as 'rapport',—a harmonious interpersonal relationship between patient and dentist which produces a satisfied and completely relaxed individual in the dental chair. In this relaxed state the patient uncritically and confidently accepts our suggestions and efforts for his welfare, so that the minor pains connected with his dental work are tolerated and the injection of local anesthetic when actually needed is accepted without complaint of any kind.

The emotional response of rapport can be developed with almost every patient. To attain this favorable attitude in the patient a certain pattern of approach towards the individual is required, and the following steps are recommended:



Steps for Attaining Rapport

1. *Reception*: The initial reception of the patient is the first step when the two-way flow of feeling between patient and dentist begins at first contact. Aggression or resistance may make itself felt at this stage through conscious and unconscious mannerisms and expressions, so our first effort is to arouse the patient's *attention* and awareness to our concern for his welfare. This is a beginning of the "mind set" for waking suggestion, and is effected by a warm sincere approach in full sympathy with the patient, *whether his fears are warranted or not.*

2. *Recognition*: When the patient recognizes that our efforts are centered on *his* behalf, he begins to take *interest* in our method of approach. While explaining fully what is planned for his dental requirements, the need for relaxing in the dental chair is also stressed. By informing him that in the relaxed state the nerve ending contacts (synapses) are wider apart to slow down sensation impulses and raise the pain threshold to make any necessary anesthetic injection hardly noticeable, the patient becomes further advanced in the "mind set" for waking suggestion. He becomes sufficiently interested and is willing to test his dentist's sincerity.

3. *Response*: At this stage the patient's receptiveness and mind set are strengthened by the *desire* to give us the opportunity to prove ourselves, so that when we suggest that he place his right hand in ours, he readily responds. As the hand rests there we quickly withdraw support and note whether the patient's hand has fallen relaxed, or remains in mid-air, tense and rigid. If the hand has fallen we compliment the individual on his ability to relax himself so quickly; if not we repeat the experiment encouraging the patient at each attempt until he eventually learns to drop the hand with the heaviness of full relaxation. The individual is next required to raise both arms above his head, and it is then suggested that he let them both fall heavily into his lap simultaneously. When this is satisfactorily accomplished the patient is told to repeat this exercise with the suggestion that the rest of his body will automatically relax itself and will momentarily feel very heavy as the arms drop into his lap. This is repeated until the patient actually learns the difference between his original tenseness in the chair and the heaviness of full relaxation. The "mind set" is complete. The patient accepts that we are genuinely interested in his welfare, and that he can depend on us to make every effort to do whatever we promise. He now has faith in us and has the proper frame of mind to accept our ideas and suggestions without further criticism.

4. *Relaxation*: Having learned to relax himself in the dental chair, the patient, now convinced of our sincerity, follows with *co-operative action* and is agreeable to the required dental procedures. Gentleness as we perform a minimum amount of dental work (if any) at this first appointment of the extremely fearful and apprehensive patient will be remembered, and at the second visit the patient is much more relaxed and more co-operative.[22]

5. *Rapport*: The interpersonal relationship has developed to the mutual *satisfaction* of patient and dentist. The patient's confidence is now supreme, and he uncritically accepts all suggestions related to his dental requirements without resorting to the sleep state of hypnosis.

Once rapport has been established the patient becomes conditioned to the relaxed state in the dental chair with each subsequent visit, and continues to accept positive suggestion in the waking state for relief of previous objections to dentistry. It should be remembered that the patient must see us in a favorable light at all

times if we wish to maintain this established rapport.

For such *C ontinuous*
C o-operation our manner of approach must let
the patient see *C* that we are always
C onfident in ourselves as we go about our work:
C onscientious about the quality of workmanship:
C onsiderate of our patient and his feelings:
C alm, deliberate and *dependable* under all conditions
C onsistent in our attitude at all times.

These factors are recognized by the individual and build up prestige which further strengthens the bond between patient and dentist.

The positive attitude on the part of the operator not only requires the confident, conscientious, considerate, calm, and consistent manner, but also the habit of being able to make and use positive statements, in order to avoid the criticism which a negative statement might arouse within the patient. Successful response to suggestion calls for uncritical acceptance of the statements made by the dentist, and the affirmative manner raises no question. Practice in this positive way of speaking leads to a choice of words and phrases which in themselves indirectly suggest a positive attitude. Careful thought will enable us to adopt this policy wherever possible, so that "just as good" becomes used instead of its equivalent "just as bad"; "half-full" takes the place of "half-empty"; "please sit" replaces "please don't stand"; and at the chair, "this will press slightly" or "this will prick slightly" instead of saying, " This won't hurt", etc. With practice a time comes when we unconsciously use positive statements on all occasions and the positive manner becomes a natural part of us, so that our patients feel at ease and are more agreeable to co-operate in the steps for attaining rapport and in responding to waking suggestion.

Psychological Considerations of Patient

A knowledge of the forces underlying patient behavior is helpful in approaching a patient for the first time. Writers on psychology stress the value of this information for a better understanding of human behavior in *all* of our interpersonal relationships, and the dentist can turn to these sources for a deeper study of the subject.

Ryan,[17] in his *Psychobiologic Foundations in Dentistry* recognizes the value of understanding the temperament and personality of our patients in order to better serve them, and he quotes from Sheldon's[23] *Varieties of Human Physique* and *Varieties of Temperament* for a possible classification of patients according to physical attributes. The *endomorph, mesomorph,* or *ectomorph* of such classification could then be recognized when an individual entered the office, and thus, knowing the temperament of the patient, we could proceed with our steps for attaining rapport without any problem. However, Ryan does not hesitate to point out that with the infinite variety of human personalities it is impossible to classify our patients according to fixed types. It is therefore necessary to recognize each patient as an individual personality, and that the behavior peculiar to him is an unconscious defense-mechanism covering both his conscious and unconscious inner conflicts. In some patients the compulsions, repressions, and anxieties resulting from these inner problems produce hostility and aggressiveness, in others timidity, dependence, and fearfulness.

Freud[6] explains these underlying forces

which regulate behavior as due to inner conflicts where instinctual drives from the Id exert pressure on the Ego at the same time that the Superego exerts a controlling inhibitory force. In addition the Ego develops other pressures in facing reality and its environment, so that a great deal of tension is produced within the individual. It is this tension which affects the behavior of a patient in varying degree according to the situation.

Lewin[13] presents a similar understanding of our patients, based on individual needs which he labeled "peripheral" and "central" according to the ability to satisfy them. Unsatisfied needs in early life drop from consciousness to become "central" needs capable of exerting unconscious tensions whenever stimulated by frustration or upset in later life. Barker, Kounin, and Wright,[2] list a total of thirty-four needs to be satisfied for an individual to be completely balanced in his attitude and behavior.

Menninger[15] relates individual behavior to proper balance between his emotional, physical, and mental capacities. Sadler[18] in his *Modern Psychiatry* adds to these the spiritual life as a personality component, and calls for a harmonious relationship between all four components to produce the relaxed, satisfied, anxiety-free individual.

It can readily be seen that we are all afflicted with tension of some sort, and the absolutely carefree person is a rarity. We should also be able to recognize our own weaknesses and frustrations, and in doing so we are able to make allowances for the patient who with feelings of fear and insecurity, presents himself for dental treatment. A full realization of man's helplessness in relation to his early formative childhood and its far-reaching effect in the succeeding years, enables us to present a sincere feeling of sympathy and understanding towards the patient. There are times when we can even empathize with him, and not only feel *for* the individual but also *with* him. In the two-way flow of feeling of interpersonal contact at reception, the patient senses this deep consideration for him, and step number one towards developing rapport is more easily attained.

Summary

While recognizing the value of suggestion in the sleep state of hypnosis as applied to dentistry, it is also pointed out that the use of waking suggestion is available to all dentists who wish to qualify themselves with an understanding of the patient as a whole, and evaluating his individual personality. Steps for developing a rapport with the dental patient are given, and it is suggested that the dentist delve into the dynamics of human behavior for a better approach to the insecure patient who is apprehensive of dental treatment. The application of a positive approach is also recommended for a strengthening of the relationship between patient and dentist. In the highly satisfactory interpersonal reaction which develops through the de-conditioning of his fears, the patient accepts relaxation in the dental chair together with other waking suggestions pertaining to dentistry, and the dentist himself finds greater pleasure in his work as he performs this service to humanity.

BIBLIOGRAPHY

1. Ament, P.: *Relaxation of Excitable Patients with Hypnosis.* Dental Digest, Sept. 1948. 402-405. *Illuminating Facts in Psychosomatic Dentistry.* North-West Dentistry, Vol. 29. April 1950.
2. Barker, R. G., Kounin, J. S., & Wright, H. F.: *Child Behavior and Development.* New York: McGraw-Hill Book Co., 1943. p. 572.
3. Bordeaux, J.: *Hypnotic Experiments with Light and Color.* Brit. J. Med. Hyp. 1950. Vol. 1. No. 4: 7-17.
4. Brenman, M., & Gill, M. M.: *Hypnotherapy.* New York: International Univ. Press, 1947.

5. BURGESS, T. O.: *Hypnodontia—Hypnosis as Applied to Dentistry*. Cal (Coe Lab. Inc.), Feb., Mar. & April, 1951.
6. CRICHTON-MILLER, H.: *Psychoanalysis & its Derivatives*. London: Oxford Univ. Press, 1950.
7. DAVIS, L. W., & HUSBAND, R. W.: *A Study of Hypnotic Susceptibility in Relation to Personality Traits*. J. Abnorm. Soc. Psychology, 1931. **26**: 175-182.
8. GUZE, H.: *Hypnosis in the Medical Specialties including Dentistry*. Annual Review of Hypnosis Literature, 1953. pp. 17-24.
9. HERON, W. T.: *Clinical Applications of Suggestion & Hypnosis*. Springfield: Charles C. Thomas, 1950. *Dental Hypnosis and Personality*. J. Personality, Symposia on Topical Issues, 1951, 1. 349.
10. HULL, C. L.: *Hypnosis & Suggestibility:* An Experimental Approach. New York: Appleton-Century, 1933
11. LANDA, J. S.: *Dynamics of Psychosomatic Dentistry*. Brooklyn: Dent. Items of Interest Pub. Co., 1953.
12. LECRON, L. M., & BORDEAUX, J.: *Hypnotism Today*. New York: Grune & Stratton, 1947.
13. LEWIN, K. A.: *A Dynamic Theory of Personality*. New York: McGraw-Hill Book Co., 1935.
14. MARCUS, F. L.: *Hypnosis in Dentistry*. Amer. J. Orthod. Vol. 33. Nov. 1947.
15. MENNINGER, K. A.: *The Human Mind*. New York. Alfred A. Knopf, 1946.
16. MOSS, A. A.: *Hypnodontics, Hypnosis in Dentistry*. Brooklyn: Dent. Items of Interest Pub. Co., 1952.
17. RYAN, E. J.: *Psychobiologic Foundations in Dentistry*. Springfield: Charles C. Thomas, 1946.
18. SADLER, W. S.: *Modern Psychiatry*. St. Louis: C. V. Mosby Co., 1949.
19. SAMET, S.: *The Use of Hypnotism in Dentistry*. Brit. J. Med. Hyp. Vol. 2. No. 1: 44-48.
20. SHAW, L. J.: *Hypnotism in Dental Work*. Brit. J. Med. Hyp. Vol. 1. 1: 38. 1949.
21. SHAW, S. I.: *Psychosomatic Sleep Applied to Dentistry*. J. Dent. for Children, 1951. Vol. 18. No. 1: 10-14.
22. SHAW, S. I.: *Psychological Interpretation of Patient Behavior*. Dent. Items of Interest, 1951. Vol. 73. No. 7: 677-692.
23. SHELDON, W. H.: *The Varieties of Human Physique*. New York: Harper & Brothers, 1940. *The Varieties of Temperament*. New York: Harper & Brothers, 1944.
24. STOLZENBERG, J.: *Psychosomatics & Suggestion Therapy in Dentistry*. New York: Philosophical Library, 1950. *Case Reports on Bruxism and Periodic Hysterical Trismus*. J. Clin. & Exper. Hyp 1953. Vol. 1. No. 1: 67-70.
25. WEINSTEIN, J.: *Hypnotism in Dentistry*. Dental Concepts, 1950.
26. WEITZENHOFFER, A. M.: *Hypnotism:* An Objective Study in Suggestibility. New York: John Wiley & Sons, 1953.
27. WOOKEY, E. D.: *Uses and Limitations of Hypnosis in Dental Treatment*. Brit. Dent. Journal, 1938. Nov. 1.

18201 Cherrylawn Ave.
Detroit 21, Mich.

Cavity Disinfecting Agents: A Survey

WILBERT C. FLETKE, B.S., D.D.S.*

Methods of cavity medication or disinfection have been condemned periodically as empirical procedures. Although the very early treatment of carious lesions may have been based on empiricism, perhaps a small measure of credit is due the pioneers who imagined or experienced the notion that the application of some chemical agent might be helpful in maintaining the tooth in the mouth. The necessity of any medication with a germicidal agent for a prepared cavity likewise has been a point of contention. Those individuals who consider the use of drugs or chemicals unnecessary (also empirical treatment) deserve mention, for they, along with the advocates of chemical treatment, served some useful function—that of provoking deliberate clinical and laboratory investigations into the need and effectiveness of the disinfection of cavities.

The present discussion will be concerned with an evaluation of the various chemotherapeutic agents and methods which have been used for cavity medication or disinfection. The material for study has been limited to the treatment of shallow and deep cavities in vital teeth without pulpal involvement, i.e., the problem of rendering the excavated carious lesion sterile, if possible, before the insertion of one or more filling materials.

A. REVIEW OF THE LITERATURE

1. *Determination of the Positional Relationship of Bacterial Forms to the Involved and Uninvolved Portions of the Tooth*

The scientific observation that bacteria of one or more forms are associated with the carious lesion[2, 7, 11] provides the basis for the determination or decision to use or omit cavity disinfecting agents prior to the insertion of a filling material. The decision to omit a chemical agent may be based on the assumption or the evidence that either the bacteria are removed during cavity preparation or that any bacteria which remain will not endanger the tooth. Conversely, the decision to employ a chemical agent may be based on the assumption or evidence that bacteria are present after unsound dentin has been removed and, if they are present, they should be killed or inhibited in order to safeguard the biological integrity of the tooth. In either instance, the empirical treatment of a prepared cavity may be founded on erroneous assumptions. It becomes necessary, then, to determine the presence or absence of bacteria in the tooth following the usual method of cavity preparation, viz., the excavation of all softened dentin. If bacteria are present, then their position in the dentin should be a factor in the successful use of disinfecting agents.

Zander[38] performed a study in 1945 in which he prepared 10 cavities according to the principles of G. V. Black (hard dentin formed the pulpal and axial walls). The teeth were isolated with a rubber dam, prepared and then filled with a sterile stopping material to avoid contamination during extraction. The extracted teeth were fixed in Zenker's fluid immediately and subsequently decalcified, stained and sectioned. Of the 10 specimens used, four had bacteria in a few and relatively scattered tubules. The penetration of the bacteria centrally from

* Teaching Fellow, School of Dentistry, University of Michigan, Ann Arbor, Michigan

the pulpal and axial walls varied from 0.08 mm. to 1.2 mm. The distance from the pulp varied from 0.24 mm. to 1.9 mm.

Seltzer[27] made a similar study in 1941 to determine whether bacteria could be removed mechanically from carious dentin. Cavities were divided into three groups as follows:

i. shallow—no involvement of dentin;
ii. medium—dentin involved but still a layer of healthy (sound?) dentin between the wall of the cavity and the pulpal chamber after preparation;
iii. deep—little sound dentin remaining and/or possibility of exposed pulp.

All cavities were prepared under aseptic conditions. After the cavities were considered ready for filling, and before any chemical agent was introduced, shavings of the prepared dentinal surfaces were placed in culture media suitable for the growth of streptococci and lactobacilli. The bacteriological results were reported according to the following table:

	Size of Cavity		
	Shallow	Medium	Deep
Number cultured.....	72	113	49
Number positive.....	30	95	46
Number negative.....	42	18	3

Seltzer concluded that the probability for mechanical removal of bacteria from shallow cavities was slightly greater than 50 per cent. In addition, he concluded that once the dentin was penetrated or involved, the success of removal varied inversely with the size (depth?) of the cavity.

Dorfman, Stephan and Muntz[9] performed a bacteriologic study in 1943 based on the premise that it was necessary to ascertain the depth of penetration of bacteria in the dentin in order to (i) determine the amount of dentin which should be excavated in order to reach the level of uninfected dentin and (ii) determine the thickness of the residual infected dentin which must be penetrated by a germicide in order to render the prepared cavity sterile. Samples were taken from each of 20 carious teeth following an initial washing in a jet of warm water to remove loose debris. Sterile burs were used to obtain the samples from five different layers of dentin, the approach being from the carious surface. An uninvolved surface of the same tooth was ground carefully with a sterile stone to expose the apparently intact and sterile dentin. Then samples were taken from each of the five layers in the reverse order of the first procedure, and all samples were cultured. The results of the culturing indicated that the superficial carious layers of the dentin were always infected and the middle and deep carious layers were sometimes infected. The partially decalcified dentin adjacent to sound dentin and the sound dentin itself were almost always sterile. These investigators concluded that a zone of decalcified sterile dentin lay between the infected demineralized layers and the sound and sterile dentin.

2. *Determination of Bacterial Forms Which are Associated With the Infected Portion of the Tooth*

In the preceding section of this report the positional relationship of bacterial forms to the cariously involved and uninvolved portions of the tooth was considered. The present section will be concerned with a brief discussion of the bacterial forms most frequently found in association with the carious lesion.

Canby and Bernier[7] cultured scrapings from superficial carious material and, also, from deep carious material in order to

determine the types of bacterial present in these strata of the lesions. Lactobacillus acidophilus was isolated in 31 instances (93.9%), eight times in pure culture from superficial carious material. Results of culturing deep carious material showed the presence of Lactobacillus acidophilus 21 times (91.3%), 18 times in pure culture. Organisms identified after isolation from mixed cultures containing Lactobacillus acidophilus were those normally present in saliva. The other organisms were, in order of frequency of appearance:

i. Streptococcus viridans
ii. Neisseria catarrhalis (or a closely allied species)
iii. Micrococcus gazogenes (a proteolytic form)
iv. Staphylococcus albus
v. Occasionally gram positive aerobic spore forming bacilli

note: Yeasts, diphtheroids, actinomyces, fusiform bacilli or leptothrix were not reported.

Besic,[2] in a less detailed study during 1943, prepared cavities in 10 carious teeth, cultured the dentinal surfaces and then sealed the teeth with sterile cotton, gutta percha and zinc phosphate cement. The bacteriologic report showed the presence of the following organisms:

gamma streptococci	present in 6 teeth
S. viridans	present in 2 teeth
L. acidophilus	present in 5 teeth
staphylococci	present in 2 teeth

Periodic culturing of the prepared cavities was performed in order to determine the survival time of the bacteria sealed in the teeth (no chemical disinfecting agents were employed). Lactobacilli were not found after a 2- to 10-month period, while the streptococci persisted for more than a year.

Enright, Friesell and Trescher[11] cultured scrapings from incipient lesions in order to identify the type of organisms present in carious teeth. Their study was more detailed and the number of bacterial forms identified was larger, as table 1 illustrates.

TABLE 1

Bacterial Type (Names from Manual of Bergey)	19 Cases of Progressive Caries		31 Cases of Negative or Nonprogressive Caries	
	No. of times found	Percentage	No. of times found	Percentage
M. conglomeratus	4		3	
M. ochraeus	3		2	
G. pseudodiphtericum	6		13	
N. sicca	3		5	
Str. mitor	16	84	29	94
L. acidophilus (Y-type)	18	95	7	23
G. crassus	3		6	
Pseudomonas	2		1	
L. buccalis	17	90	23	74
B. mesentericus	2		3	
N. flavus	9	47	9	26
B. fusiformis	1		1	
Str. albus	2		4	
N. perflavus	10	53	17	55
N. catarrhalis	1		2	
Cl. placoides	0		4	
H. Influenzae	0		2	

Note: Only the significant percentages were included.

Burnett and Scherp[5] concluded in 1951 that proteolytic bacteria were found throughout the carious lesion. In addition, lactobacilli and other aciduric organisms made up a major fraction of the organisms cultivated from carious enamel and were found regularly, though in a smaller proportion, in deep carious dentin. In many instances they were absent from the superficial layers of carious dentin.

3. *The Determination of Those Agents Which Have Been Shown to be Effective in Controlling the Action of Bacteria Associated With the Carious Lesion*

a. *In Vitro Studies (methods employed)*

Gershenfield, Pressman and Wood[12] (1933) analyzed the bactericidal efficiency and toxicity of creosote and its

TABLE 2

	Days		
	2	4	7
Before treatment			
Sound dentin control	−	−	−
Carious dentin 1.5 mm. from surface	+	+	+
After treatment			
Superficial layer	−	−	−
0.5 mm. layer	−	−	−
1.0 mm. layer	−	+	+
1.5 mm. layer	+	+	+

TABLE 3

Agent	Time	Average Depth	Mean Deviation
Saturated silver nitrate...	1	0.3	0.1
Saturated silver nitrate...	3	0.5	0.3
Saturated silver nitrate...	10	1.3	0.3
Howe's ammoniacal silver nitrate	3	0.8	0.4
Superoxol	3	0.4	0.4
Superoxol	3	0.4	0.4
20% Zephiran	3	0.0	0.0
25% Phenol	3	0.0	0.0

components. The phenol coefficient of various commercial samples ranged from 2.4 to 3.9 for B. typhosus and Staph. aureus. The average coefficient was 3.2. Two major components, guaiacol and cresol, were found to be less than half as bactericidal as creosote. Dimethylphenols (xylenols) and ethyl guaiacol were, according to the method of testing, more active bactericides than either creosote or guaiacol alone.

In a study of the bactericidal properties of pure metals and metallic filling materials, Sheppard[33] (1935) found no correlation between any bactericidal effect of a filling and the recurrence of caries in the substance of the tooth adjacent to the filling.

The diffusion of 90 per cent phenol through the tooth, both from within and without, was investigated by Thomas[37] in 1941. The method of the study consisted of swabbing prepared cavities with 90 per cent phenol colored with a dye (eosin Y). The teeth then were wiped with cotton and sealed with cement. Photographic evidence was presented to show the diffusion of the phenol to the wall of the pulp chamber. Eosin-dyed phenol also was sealed into pulp chambers of freshly extracted teeth and Thomas demonstrated the diffusion of the mixture outward, not only through the dentin, but also through the cementum.

Ross[25] (1941) concluded that ammoniacal silver nitrate, precipitated on the surface of freshly prepared, noncarious dentin, rendered the dentin impermeable to methylene blue.

Stephan, Dorfman and Muntz[36] developed a method for determining the thickness of infected dentin which could be rendered sterile by a saturated solution of silver nitrate. Carious teeth were mounted on an assembly which held handpieces on adjustable micrometer fittings. Samples of sound and carious dentin, taken before and after treatment with silver nitrate, were obtained by entering the carious and the intact areas of the teeth. Culturing was continued for seven days and the results, as recorded, are shown in table 2.

Variations in time of application were made with the saturated silver nitrate solution and other agents (table 3).

A description follows of two phases of another study conducted by Muntz, Dorfman and Stephan:[20]

1. Determination of antibacterial potency of various chemical agents.

Moist carious dentin, consisting of a considerable amount of firm but infected dentin, was washed with sterile water

to remove loose debris, cut to three sizes and immersed in each of the chemical agents for three minutes. The samples then were washed with drops of sterile distilled water (10 cc.), ground in a sterile mortar with 0.3 cc. of culture media and inoculated into culture tubes. Subculturing was carried out if the tubes were negative for three days (table 4).

A complete list of the chemical agents used in the experiments of Muntz, Dorfman and Stephan included:

Agent	*Concentration*
Silver nitrate	approximately 9.6 molar
Copper nitrate	approximately 5.7 molar
Cadmium nitrate	approximately 5.4 molar
Mercury bichloride	approximately 0.3 molar
Merthiolate	approximately 2.0 molar
Hydrogen peroxide	30% solution (superoxol)
Iodine	10% iodine in 10% potassium iodide
Chloramine T	14% solution
Liquid phenol	90%
Beechwood creosote	Mallinkrodt's, USP
Neutral acriflavine	20%
Neutral acriflavine	20% with 0.2% tyrothrycin
Zephiran chloride	approximately 20%
Phemerol	approximately 10%
Ethyl alcohol	70% by weight
Urea	saturated solution

Only silver nitrate solution and 30 per cent hydrogen peroxide sterilized samples from 0.8 mm. to 1.4 mm. thick, but not in all samples.

	Thickness of Sample	
	1.1–1.5 mm.	0.8–1.0 mm.
Silver nitrate	64% sterilized	84% sterilized
Superoxol	42% sterilized	55% sterilized

2. Determination of the depth of penetration of silver nitrate in carious dentin. The following sketch illustrates the manner in which pieces of dentin were mounted for the application of the silver nitrate and for subsequent sectioning.

By applying the solution at b instead of a, the investigators attempted to eliminate any possible ease of diffusion through the remnants of the tubules.

TABLE 4

Germicide	24 Hours			48 Hours			72 Hours		
	1	2	3	1	2	3	1	2	3
control	+	+	+	+	+	+	+	+	+
silver nitrate (saturated)	−	?	−	−	+	−	−	+	−
70% ethyl alcohol	+	+	+	+	+	+	+	+	+
10% iodine	−	?	?	+	+	+	+	+	+
30% hydrogen peroxide	−	−	−	−	+	−	−	+	−
saturated chloramine-T	?	+	−	+	+	+	+	+	+

Thickness of specimen: (1) 1.1 to 1.3 mm.; (2) 1.3 to 1.5 mm.; (3) 1.0 to 1.2 mm.

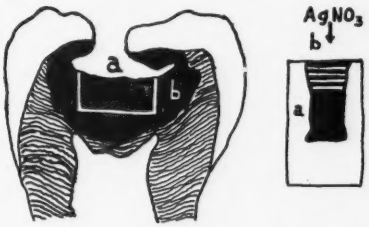


FIG. 1
(From Muntz, Dorfman, and Stephan[20] p. 1896.)

The paraffin was shaved off to expose the dentin; a saturated solution of silver nitrate was applied for three minutes (also 10 minutes); the area was washed with sterile distilled water and serial sections 0.25 mm. thick were cut off. These sections were divided in two so that one piece could be cultured and the silver content of the other could be determined. Four sections were made of each of the 15 specimens (table 5). Regarding the relation between the depth of penetration of silver nitrate and the depth at which sterilization occurred, it was found that a 3-minute application uniformly sterilized at least 0.25 mm. of carious dentin. In approximately half of the experiments, a 3-minute application

TABLE 5

Section	3-Minute Application	Section	10-Minute Application on 11 Specimens
	Results of Culturing		Results of Culturing
1	negative	1	negative
2	50% negative	2	2+, 9−
3	positive	3	3+, 8−
4	posiitve	4	7+, 4−

TABLE 6

Agent	% Negative Cultures	
	Early—taken within 10-30 minutes	Late—taken within 2½-3 hours
ammoniacal silver nitrate*	72	50
silver fluoride (80%)	12	71
silver chlorate	40	67
zinc iodide*	69	22
penicillin*	78	0

Agent	Index
silver nitrate 30%	64
sodium nitrate 14%	
zinc nitrate 33⅓%	50
copper nitrate 33%	43

*Broken down early in carious lesion.

sterilized to a depth of 0.5 mm. In 10-minute applications the depth of sterilization increased to 0.75 mm.

One of the studies conducted by Lawyer, Bibby and Zander[17] involved the use of an antibiotic agent. Individual mixtures of zinc oxide containing creosote, and other mixtures containing streptothrycin, embedded in agar plates treated with saliva, produced equal zones in which bacterial growth was inhibited. Freshly extracted carious teeth, immersed in solutions of 250-unit streptothrycin for two hours, yielded negative cultures from carious dentin and tooth surfaces.

Hardwick[14] completed an extensive series of tests on the sterilization of carious dentin. The in-vitro portions of his tests will be described. Extracted carious teeth (1,000) were washed with a jet of water at 37°C, individual cavities were dried and various chemical agents were applied for two minutes. Three cultures were obtained from each tooth after washing with water at 37°C and removing sound enamel to expose sound dentin with a slowly revolved stone. A sample of the sound dentin was secured with a sterile bur (sample A), and the same bur was used to obtain samples B and C from the treated lesion. The superficial layer of the lesion was not penetrated by the bur.

Sample A cultured in glucose broth (sterile surface culture)

Sample B cultured in glucose broth (from treated lesion)

Sample C cultured in 1% gelatin (from treated lesion)

If A were positive, the entire series for that test was discarded; however, if B and C were negative, the assumption that the entire cavity was sterile could not be made; therefore, A had to remain negative to make the test valid. An index of the bactericidal efficiency for each agent was obtained by comparing, as a percentage, the number of tests providing negative cultures with the total number of tests for that agent.

Table 6 shows examples of the comparison of the results of early and late culturing and the comparison of germicidal indices of aqueous solutions of silver, zinc and copper nitrate:

The following list of compounds tested by Hardwick illustrates the completeness of his investigation and provides the reader with a table for comparison with

other studies. (Note: the compound following the dash is the precipitant):

Agent	*Index of Bactericidal Efficiency in %*
1. Ammoniacal silver nitrate-eugenol	65
2. Saturated silver nitrate	74
3. 80% silver fluoride	45
4. Saturated silver chlorate	57
5. Saturated copper nitrate	47
6. Saturated copper sulphate	19
7. Saturated zinc iodide	53
8. Saturated zinc chloride	50
9. 27% silver nitrate	39
10. Saturated mercuric nitrate	33
11. Saturated chromic acid	50
12. Dilute ammonia water	29
13. 80% silver fluoride—calcium chloride	43
14. 80% silver fluoride—cupric nitrate	75
15. Zinc phosphate cement liquid	50
16. Zinc phosphate cement liquid-magnesium carbonate	43
17. Hydrogen peroxide (10 volume)	27
18. Penicillin (50,000 units per ml.)	40
19. 10% aqueous iodine solution	27
20. Liquor iodi mitis	29
21. Concentrated metaphen	29
22. Concentrated Dettol	12
23. Concentrated T.C.P.	33
24. Concentrated Milton solution	32
25. Oil of cloves	30
26. Zinc oxide eugenol mixture	53
27. Copal ether varnish	44
28. Ether	27
29. 95% ethyl alcohol	22
30. Pure liquid phenol	15

Another phase of Hardwick's study included a histological examination in order to demonstrate the effects, if any, upon the pulp produced by the more successful germicides which had been determined in the first part of his investigation, and to show the depth of penetration of these germicides in prepared cavities. The conclusions drawn from the microscopic study of the application of ammoniacal silver nitrate are as follows:

1. The silver was limited strictly to dentinal tubules opened by the preparation of the cavity.
2. The silver solution diffused into dentinal tubules which were opened on the pulpal side of the dentino-enamel junction.
3. Only rarely did the silver enter the pulp.
4. The precipitated silver existed in the dentin as:
   a. large discrete granules
   b. very fine diffuse staining
   c. dense blockage of dentinal tubule
5. When thorough impregnation occurred, all the channels of dentin appeared to be involved.
6. Application of silver nitrate to carious dentin resulted in a superficial zone of staining in which all structural detail was obliterated to a depth of 1 mm.

Stamps[34] introduced a simple method for the simultaneous evaluation of the penetrating and disinfecting ability of chemical agents in dentin. Cavity preparations were prepared in freshly extracted posterior teeth, leaving 2 mm. between the pulpal floor of the cavity and the pulp. The crowns of the teeth were removed and positioned on glass tubes filled with inoculated agar. Various chemical agents were placed in the prepared cavities and the penetrating and disinfecting abilities were evidenced by inhibition of bacterial growth in the agar beneath the crown. Penetration by phenol was observed in approximately 55 per cent of the teeth, while beechwood creosote penetrated the 2 mm. of dentin in approximately 82 per cent of the teeth.

b. *In Vivo Studies (methods employed)*

Rosenstein[24] selected 53 primary and 78 permanent teeth with deep cavities which would have resulted in exposed pulps had all of the carious dentin been removed. Only the deepest layer of carious dentin was left in the cavity and ammoniacal silver nitrate was precipitated by eugenol into this layer. The period between the time of application and the time of checking extended for five years. For the treated primary teeth, 87 per cent, or 46 of the original 53 were

TABLE 7

Agent	Per Cent Negative Cultures	
	Before Treatment	After Treatment
No agent used (control)	no appreciable change	
Morson's creosote	18	86
10% aqueous iodine solution	21	78
100% liquid phenol	23	69
Normal saline solution	19	44
Isotonic iodine solution	22	44
*50% thymol in ethyl alcohol	22	39
*50% phenol in ethyl alcohol	22	29
Howe's ammoniacal silver nitrate solution	20	28
95% ethyl alcohol	19	19

* For these agents, there was no appreciable effect, since the final figure was determined on fewer cases which returned for checking.

returned for checking and 89 per cent, or 41 of these teeth were considered successful. For the treated permanent teeth, 82 per cent, or 64 of the original 78 were returned for checking and 97 per cent, or 63 of these teeth were considered successful. More than half of the total successful teeth were retained in position and function for from one and one-half to four years.

Easlick[10] observed that of 22 primary molars with nearly exposed pulps, only one degenerated in the period of over a year after receiving the routine clinical treatment by fresh ammoniacal solution of silver nitrate precipitated with eugenol, followed by cavity lining varnish, zinc phosphate cement and silver amalgam.

Ireland[15] precipitated an ammoniacal solution of silver nitrate by eugenol in 100 selected cavities in which the pulps were nearly exposed. No devitalization of the pulps occurred following such treatment.

Seltzer[28] performed a series of experiments on the efficacy of various chemical agents in rendering prepared cavities bacteriologically negative. The procedure was identical to that described on page 3 of this report (cf) up to and including the culturing of the prepared dentinal surface. Table 7 shows the drugs which were used, and they are arranged in decreasing order of efficacy.

Seltzer[29] re-examined 93 of the treated teeth of his previous study[28] one year after treatment to determine the effective duration of the cavity disinfecting agents. Of 12 original cases where no chemical agent was used, 10 were bacteriologically positive. Of 58 originally positive teeth, 42 (73%) failed to become negative in 12 months.

In still another study, Seltzer and Werther[32] performed the following steps over a period of 7 to 18 months on teeth which were in imminent danger of pulpal exposure by caries: a radiograph was secured; the teeth were isolated with a rubber dam; superficial necrotic tissue was removed and ammoniacal silver nitrate was precipitated by eugenol. The cavities were sealed carefully with a mixture of zinc oxide-eugenol. During the second appointment the stained carious dentin was excavated, the treatment with silver nitrate was repeated and another radiograph secured. The procedure during the third appointment was the same except that the permanent filling material also was inserted. Serial radiographs demonstrated the laying down of secondary dentin causing the pulps to recede from the original sites of near exposure. During the test, 10 pulps were exposed and treated directly with the silver nitrate. At the end of the study six still were vital, two were

TABLE 8

	Before				After				% Negative or Effective
	Medium		Deep		Medium		Deep		
	+	−	+	−	+	−	+	−	
no sterilization (control)	10	0	10	0	9	1	10	0	5
70% ethyl alcohol	10	0	10	0	8	2	9	1	15
10% aqueous sodium carbonate	10	0	10	0	8	2	10	0	10
Phenolate	10	0	10	0	1	9	2	8	85
Hexylresorcinol	10	0	10	0	3	7	5	5	60
Beechwood creosote	10	0	10	0	5	5	8	2	35
Zephiran	10	0	10	0	5	5	6	4	45
Metaphen	10	0	10	0	3	7	4	6	65

extracted, and two of these patients failed to return.

Seltzer,[30] in an additional study of the effectiveness of antibacterial agents, reported the bacteriological results shown in table 8 after using the same method as was described on page 3 of this report, except that only two classes of cavities were used.

Phenolate (a mixture of isomeric chlorphenolates) exhibited the most effective antibacterial property.

Stephan, Muntz and Dorfman,[36] in an in-vivo phase of their investigations in 1943, tested the ability of a saturated solution of silver nitrate to sterilize carious dentin left in a cavity. A layer 1 mm. to 2 mm. thick was left and treated and the cavity then was filled with zinc oxide-eugenol mixture. The carious portion was removed after 24 hours and cultured for four days. The results indicated that, of 17 treated cavities without exposed pulps, 17 were negative. Of 12 treated cavities exposing the pulps, three were positive, the condition being attributed to infection from the pulp.

Day[8] determined that the phenol coefficient of thymol (using pure cultured organisms found in carious teeth) was 23.4. He presented a radiographic and bacteriologic series on seven teeth in which deep residual carious areas were treated with melted thymol crystals over a period of five years. Upon reculturing, all but one of the areas were found to be negative for bacterial growth.

The correlation between the penetration of silver nitrate into dentin and the flow of the so-called dental lymph was studied by Zander and Smith.[39] Degenerative changes were produced in the dentin by severe methods of preparing cavities, followed by fillings of zinc phosphate cement.[38] A solution of silver nitrate was applied to those teeth which had undergone degeneration of the dentin, irregular formation of dentin and pulpal injury. For controls, the solution was applied to dentin which had not been subjected unduly to disturbing chemical and physical treatment and to the dentin of pulpless teeth. No appreciable differences were noted between the penetration of the product of the precipitated solution of silver nitrate into degenerated but still vital dentin (through so-called calcific barriers and irregular dentin into the pulp chamber) and the penetration into sound dentin and dentin of pulpless teeth. The penetration of silver nitrate could not be correlated

with the flow of a dental fluid or lymph.

Lawyer, Bibby and Zander[17] sealed a mixture of zinc oxide and 250 units of streptothrycin into three cavities freshly prepared in sound teeth and two carious cavities. Zinc oxide-creosote mixtures also were sealed into the same number and type of cavities. All cavities in sound teeth and the carious cavities (2 mm. thick) treated with streptothrycin were negative, while the carious cavities treated with creosote yielded mixed cultures.

Rabinowitch[22] observed that ammoniacal silver nitrate reduced with eugenol exhibited a penetration "en masse" to the limit of the decalcified portion of the tooth. Histological sections showed a less concentrated penetration of the agent deep to the decalcified zone, which continued through secondary dentin to the pulp. The continued formation of secondary dentin was observed in most of the teeth.

Miller and Maeglin[19] treated dentin with a 40 per cent solution of zinc chloride and followed with a precipitant of 20 per cent potassium ferrocyanide. The observations were that the zinc ferrocyanide effected complete closure of dentinal tubules so that they were not penetrated by solutions of silver nitrate. Zinc ferrocyanide also exhibited the capacity of preventing growth in serum inoculated with organisms from carious lesions.

B. Discussion and Evaluation of Subject Material Covered in Review of Literature

The report by Zander[38] was of limited significance; however, his findings were in accord with those of Seltzer[27] and those of Dorfman, Stephan and Muntz.[9] The methods used and data secured by Seltzer[27] were convincing; however, actual measurements on histologic sections would have been desirable. In the first two studies presented,[38, 27] the possibility of contamination of the underlying dentin by mechanical means (grinding or pumping bacteria deeper into the dentin) remained a possibility. The structure of the dentin easily could have permitted a redistribution of organisms, especially in the deeper layers. The diameter of the dentinal tubules centrally is three to four microns, while at their peripheral ends the caliber is one micron. In addition to these observations, the ratio of the number of tubules per unit area in the pulpal and outer areas is four to one.[3] It is not unlikely that the structure of the dentin close to the pulp would enhance penetration of bacteria.

A further consideration of the observation that bacteria may be present in some dentinal tubules and absent in others may be reconciled, in part, by reference to Bodecker's[4] classification of dental carries into acute (rampant) and chronic types. The classification affords a simple descriptive device and is based mainly on the character and location of the lesion and the degree of post-formative calcification of the dentin. In the acute type, the decalcification and proteolysis of the dentin occur at a rate which precludes the deep invasion of the tubules by the bacteria. The chronic type is characterized by a slower disorganization of the dentin, and the bacteria have an opportunity to invade some of the tubules beyond the line of destroyed dentin (decalcification and proteolysis to form the softened and stained dentin which is usually excavated during the preparation of cavities).

The data presented by Dorfman, Stephan and Muntz[9] provided a contrast to the reports of Zander[38] and Seltzer,[27] in that there was supposedly a sterile

decalcified zone between the infected decalcified dentin and the sound and sterile dentin. Even the two deepest zones of the teeth which were studied were not absolutely free of bacteria in all instances. The methods of Dorfman, Stephan and Muntz, and the number of specimens used, would indicate that the figures were significant according to the investigators' arbitrary division of the teeth into five zones or strata. Their findings would have been more valuable if actual measurements and histological studies would have been made and correlated.

Bartels[1] presented a description of the method of decalcification of dentin after penetration of the enamel, based on the evidence that acidogenic organisms are essential for the removal of the inorganic portion of the dentin.[5, 13] A mixture of saliva, fermentable carbohydrates and micro-organisms in the cavity undergoes fermentation, and the acid which is produced diffuses farther into the dentin, becoming limited in its penetration through neutralization as it combines with the inorganic salts. This process occurs and proceeds in advance of the organisms. Canby and Bernier[7] were in agreement with the statement that the unsoftened dentin between the carious lesion and the pulpal chamber was often sterile upon culture. Bartels also explained why, in certain instances, bacteria may be found deep in sound dentin beyond the level of decalcification. As the process continues deeper in the dentin, the available moisture (from the oral side of the cavity) for the functioning of the particular systems of bacterial enzymes becomes less; fewer bacteria survive and the acid is less concentrated; and the bacteria which are capable of survival may have the opportunity to penetrate the tubules ahead of the more slowly decalcified zone. These same bacteria, when left in dentin under a hermetically sealed filling, would be deprived of almost all available moisture and then would either die or become dormant.

Although the evidence presented by a number of investigators[2, 9, 27, 38] would favor the conclusion that bacteria are present in clinically sound dentin, Hardwick[14] conducted experiments in 1,000 teeth, all of which had a sterile, sound zone of dentin beneath the carious lesion (p. 11 this report). Hardwick presented no data, however, on the number of teeth which were discarded when they did not fulfil the requirements of his method of testing.

None of the investigations presented in the first section of this report afford the basis for a conclusion that bacteria do not, in some instances, invade the dentin ahead of the decalcified zone.[21]

The reports of Canby and Bernier,[7] Besic,[2] and Enright, Friesell and Trescher[11] varied somewhat in the number and types of organisms usually found in their carious dentin. The data were presented, however, to illustrate the point that none of the bacteria are noted for any unusual resistance to chemical treatment,[6] which treatment will be discussed in the latter sections of this paper.

Although Gershenfield, Pressman and Wood[12] employed the rather incomplete method of the phenol coefficient for determining the bactericidal effect of creosote and its components, their study explored the possibilities of the fractions of creosote, a compound which certain investigators[17, 20, 28, 34, 36] have reported as adequate. Sheppard's[33] exhaustive tests demonstrated clearly that one cannot rely on metallic fillings, per se, to render the subjacent dentin sterile, a point to be considered later in the dis-

cussion of the effectiveness of silver nitrate.

Phenol is one of the two most frequently used drugs for disinfection of cavities.[21] Its use may have developed from the observation that phenol is a potent germicide when placed in direct contact with the common organisms of the oral cavity. The reports on the penetration of phenol in dentin vary markedly from a finding of complete penetration[27] through little or no penetration.[36] Seltzer[28] found phenol moderately effective for disinfection; however, he did not report any data on the depth of penetration.

The objection may be raised regarding the conclusion of Thomas[27] that 90 per cent phenol may diffuse freely through dentin and cementum. Eosin Y, a water soluble dye, was used as a tracer in the phenol. The dye may have been more soluble in the electrolyte of the tooth than it was in phenol and thereby was afforded an easy means of diffusion through the dentin. No circulation of a dentinal lymph is implied in this discussion. Diffusion of the dye following incubation of the teeth could have been caused or enhanced by increased vapor pressure of the phenol-eosin mixture in the pulp chamber. Furthermore, no criterion for the germicidal effect of such diffused phenol was established. Similar criticism is directed at Ross'[25] work with ammoniacal silver nitrate and methylene blue, that is, no actual measure of penetration or bactericidal effect after penetration was proved.

The in-vitro studies by Stephan, Muntz and Dorfman[36] added further evidence that phenol does not penetrate dentin appreciably. These investigators also confirmed Miller's[18] experiments with hydrogen peroxide—that it cannot penetrate carious dentin because of the severe effervescence which occurs. The enzyme, peroxidase, is present in carious dentin and it catalyzes the breakdown of hydrogen peroxide.[36]

In another series of tests of the antibacterial potency of various chemicals by Muntz, Dorfman and Stephan,[20] the investigators stated that they drew no conclusion regarding the penetration of the numerous agents into carious dentin by their method; however, they presented the finding that only silver nitrate and superoxol sterilized pieces of dentin 0.8 mm. to 1.4 mm. thick—but not in all cases. The method of grinding the samples in a mortar with the culture media seems to have reduced the test from one of an actual measure of penetrability to one of a measure of apparent germicidal effect. The antibacterial effect could have been due, reasonably, to the alteration of the surface of the carious samples (a crushing or plugging of the tubules or their remnants to form a pellicle or hull around the sample) which provided a purely mechanical barrier between the bacteria in the dentin and the culture media.

In the second phase of the study under discussion,[20] the penetration of silver nitrate was shown to be less than one millimeter (10-minute application) when no external forces, such as trituration, were employed. Regarding the degree of desiccation of a cavity, Bartels[1] stated that reduction of the moisture in dentin by drying would be detrimental to the ionization and diffusion of a water soluble germicide. The mode of application (see sketch, p. 10) does not seem to be critical unless penetration only in the direction of line p is considered. In fact, the tubules are cut on a diagonal plane which would expose more of the inner surfaces than would a transverse cut.

Lawyer, Bibby and Zander[17] presented the results of an interesting but limited application of an antibiotic agent which apparently rendered carious dentin sterile, but no report was included to indicate its effect on clinically sound (but possibly infected) dentin.

The impressive series of experiments and the number of disinfecting agents used by Hardwick[14] provided significant data on the problem of cavity disinfection. Of the 30 chemical agents employed by Hardwick, highly ionized salts of heavy metals were the most effective, of which silver nitrate displayed the highest germicidal properties. It seems appropriate to present a statement of the properties which a highly ionized salt solution should have in order to be an effective germicide of infected dentin. The following points were proposed by Hardwick:[14]

1. The basic radical should be highly bactericidal.
2. The acidic radical should be highly bactericidal.
3. The salt should be highly soluble in water.
4. The acidic radical should not react with the calcium present in carious dentin to form an insoluble salt.
5. The basic radical should not react with phosphate to form an insoluble product.
6. If a self limiting action following application to freshly opened dentin is desired, the chloride salt of the basic radical should be insoluble in order that it may be precipitated by the chlorides of the tissues.
7. If the salt is easily reduced, it will act more quickly as a germicide and at the same time will be precipitated rapidly by fluid protèins making it more self limiting.

Some simple cations and anions are arranged below in decreasing order of toxicity to bacteria.[14]

Cations	*Anions*	
silver	hydroxide	hypophosphite
mercury	fluoride	chlorate
copper	chromate	sulphite
zinc	monobasic phosphate	nitrate
calcium	perchlorate	chloride
ammonium	iodide	sulfate
potassium		
sodium		

According to the foregoing schedules of requirements and the ion toxicity, silver fluoride, a highly soluble salt, should provide excellent germicidal action. Silver fluoride, however, is decomposed readily and the calcium fluoride and silver phosphate formed in the reaction impede penetration because of their insolubility. Zinc iodide and penicillin also undergo early decomposition. A solution of silver nitrate fulfils nearly all of the requirements which were listed for an effective aqueous germicidal solution.

The conclusions drawn in the histological section of Hardwick's study were well substantiated with photomicrographs. With the exception of points 1 and 2 (p. 13 this report), Hardwick's conclusions were comparable to, if not identical with, the findings of Rabinowitch.[22] In addition, an important conclusion reached in this study was that the diffusion of the solution did not depend upon the circulation of so-called dental lymph. Zander and Smith[39] developed the same conclusion based on equally significant and convincing data.

The method which Stamps[34] presented for measurement of permeability of dentin showed a remarkable resemblance to the results which Seltzer[28] obtained in vivo with Morson's creosote and phenol. The measurement of the inhibition of bacterial growth once the disinfecting agent has reached the agar, however, would remain an indication of the rate of penetration. Whether complete

sterilization of the dentin would be effected even though the agent apparently passed through it (or part of it) would require additional study.

The similar clinical observations of Rosenstein,[24] Easlick,[10] Ireland,[16] Stephan, Muntz and Dorfman,[36] and Rickert[23] on teeth treated with ammoniacal silver nitrate provided evidence that silver nitrate was at least as effective as other chemical agents used in clinical studies, especially when the pulp was in danger of carious exposure. The tests by Day,[8] using thymol, or the tests by Seltzer,[28, 29, 30] in which a variety of chemical agents were used, were used as the basis of comparison.

Seltzer and Werther,[33] Stephan, Muntz and Dorfman,[36] and Rabinowitch,[22] using slightly varied but related technics, produced surprisingly similar results with ammoniacal silver nitrate. Consistently, the solution was more successful than any other agent tested. Seltzer[27] and Rabinowitch[22] agreed that the capacity of the odontoblasts to form secondary dentin was not impaired following treatment by silver nitrate.

The effectiveness of either saturated silver nitrate[20] or ammoniacal silver nitrate[14, 32] may be analyzed from at least two aspects:

i—that the compound provides a stimulus to the odontoblasts to form secondary dentin, which activity produces a mechanical barrier to the bacteria from the pulpal side[22, 32] (the filling would provide the external seal for the entrapped organisms). The theory that the bacteria would produce no further destruction of the tooth would be in agreement with the findings of Bartels[1] and Besic.[2]

ii—that silver nitrate exerts a bactericidal effect by contact with and destruction (or inhibition of the organisms;[14, 19, 36] but according to Sheppard's[33] conclusions, a metal such as silver may not be expected to exhibit any appreciable bactericidal efficacy. In the form of a highly ionized salt, however, the metal may be rather active. The important factor to be considered is that prior to the time of precipitation, a highly ionized salt solution, such as silver nitrate, may exhibit or produce its most effective toxic action on bacteria. Hardwick[14] concluded that in those instances in which a more thorough disinfecting activity was observed, the penetration of silver nitrate was more diffuse. In other words, when the solution of silver nitrate was able to penetrate without being precipitated early, it remained in a more toxic form. The process of precipitation of silver nitrate, i.e., the reduction of the salt to produce the black metallic stain, may be likened to the exposure and processing of a radiograph—the emulsion is affected by the x-rays to produce the latent image, but in order to see the final image which is comprised of microscopic grains of metallic silver, the film must be developed and fixed. The precipitate of metallic silver may serve merely as a marker to indicate the depth at which a previous bactericidal effect was produced.

Day's[8] clinical and radiographic studies of seven teeth treated with pure thymol were based on an extensive bacteriological investigation in which phenol and thymol were matched for their germicidal effect on pure cultures of organisms associated with the carious lesion. Day's method of determining the phenol coefficient of thymol was at least a refinement of the standard method, but other chemicals have been shown to have a higher germicidal effect than phenol when measured in dentin.[14, 27, 28] The presentation of but seven teeth limited the value of Day's

investigations into the germicidal properties of thymol.

Miller and Maeglin[19] conducted a limited study which was as inconclusive as the work performed by Ross.[25] Penetration of an agent into the dentin does not prove any germicidal efficacy. Hardwick[14] concluded that although saturated zinc iodide and zinc chloride solutions were moderately active germicides, the iodide was very unstable, while the chloride was not self-limiting and, therefore, could irritate the pulp.

C. Recommendations

1. The relation between length of application (for a single application) and degree of penetrating and disinfecting ability of silver nitrate requires additional investigation.

2. The black metallic precipitate may be a by-product of the effective activity of silver nitrate. Further studies may be directed toward:

a—determining the possibilities of using silver nitrate (or a related compound) without obtaining the objectionable discoloration;

b—determining the reduction or increase in germicidal activity of silver nitrate if the discoloration can be controlled.

D. Summary

Studies of the positional relationship of bacteria to the dentin remaining in a prepared cavity were reviewed. No conclusive evidence was presented regarding the absence of micro-organisms from clinically sound dentin.

Several reports on the types of bacteria associated with the carious lesion were presented. Types and percentages were illustrated by means of tables. The resistance of the common flora of carious lesions to simple chemical treatment was examined.

A review and analysis of the literature pertaining to tests in vitro for germicidal agents affords the basis for the following statements: (1) A high degree of penetration of phenol in dentin is questionable, and significant evidence of the potency of the germicidal action following any penetration is lacking; (2) A variety of tests, conducted by a number of investigators, proved either the inability of several chemical compounds to penetrate the dentin or to affect bacterial metabolism after penetration. Commonly employed disinfecting agents for cavities, such as phenol, beechwood creosote, ethyl alcohol, generally were ineffective. Ten per cent iodine solutions and Morson's creosote exhibited moderate germicidal activity; (3) Ammoniacal silver nitrate and the saturated solution of silver nitrate were capable of producing the most consistent penetration and disinfection. Reasons for the deep and diffuse penetration in some instances and rather limited penetration in other instances were not developed fully. The length of the time of application was determined to be one factor; (4) Tyrothrycin, although examined in a limited investigation, exhibited excellent bactercidial properties. Data on the uses of tyrothrycin and penicillin for disinfection of cavities were limited and, therefore, judgment on their properties should follow more detailed studies.

Several reports on in vivo studies also were examined for their correlation with laboratory tests and with clinical observations. (1) Those clinical procedures in which silver nitrate was used exclusively were significantly devoid of reports on the irritating or destructive properties of the chemical on the pulp. Radiographic evidence verified the production of

secondary dentin; (2) In comparative tests involving silver nitrate and other chemicals, the silver nitrate exhibited consistently higher degrees of germicidal activity; (3) Individual studies of thymol and zinc ferrocyanide were inconclusive on the basis of data presented.

E. Conclusions

1. Bacteria associated with carious dentin may be present in clinically sound dentin following excavation of unsound tissue.

2. Most organisms present in sound and carious dentin are susceptible to simple chemical treatment providing they can be contacted for a sufficient period of time by a minimum (undetermined) concentration of the chemical agent.

3. Silver nitrate in either saturated or ammoniacal solutions is capable of disinfecting clinically sound infected dentin. The effective depth of penetration is a function, in part, of the length of time of application. (See recommendations.) The relative effective penetrating ability of silver nitrate is as high as other thoroughly tested disinfecting agents for cavities to date.

BIBLIOGRAPHY

1. Bartels, H. A. Consultant symposium: our empiric cavity sterilization. N. Y. S. Dent. J., **17:** 3-9, Jan. 1951.
2. Besic, F. C. The fate of bacteria sealed in dental cavities. J. Dent. Res., **22:** 349-54, Oct. 1943.
3. Bevelander, Gerrit. The dentin. p. 101-27. (In Orban, Balint, ed. Oral histology and embryology. 2nd ed. St. Louis, Mosby, 1949. 364 p.)
4. Bodecker, C. F. Variations in the lesions and activity of dental caries. J. Dent. Res., **16:** 51-8, Feb. 1937.
5. Burnett, G. W., and Scherp, H. W. The distribution of proteolytic and aciduric bacteria in the saliva and in the carious lesion. Oral Surg., Oral Med. and Oral Path., **4:** 469-77, Apr. 1951.
6. Burrows, William, et al. Jordan-Burrows textbook of bacteriology. Philadelphia, Saunders, 1949. XX + 981 p.
7. Caneby, C. P., and Bernier, J. L. Bacteriologic studies of carious dentin. Am. Dent. A. J., **23:** 2083-9, Nov. 1936.
8. Day, H. W. Thymol in cavity sterilization. Am. Dent. A. J., **31:** 605-15, May 1, 1944.
9. Dorfman, Albert, Stephan, R. M., and Muntz, J. A. In vitro studies on sterilization of carious dentin. II. Extent of infection in carious lesions. Am. Dent. A. J., **30:** 1901-4, Dec. 1, 1943.
10. Easlick, K. A. Pulp management for deciduous and young permanent teeth. Am. Dent. A. J., **26:** 100-12, Jan. 1939.
11. Enright, J. J., Friesell, H. E., and Trescher, M. V. Studies of the cause and nature of dental caries. J. Dent. Res., **12:** 759-851, Nov. 1932.
12. Gershenfield, Louis, Pressman, Ralph, and Wood, H. C., Jr. The bactericidal efficiency and toxicity of creosote and its components. Am. Pharm. A. J., **22:** 198-204, Mar. 1933.
13. Goadby, K. W. The mycology of the mouth. London, Longmans, Green and Company, 1903. IX + 241 p. (p. 133-41)
14. Hardwick, J. L. Sterilization of carious dentine. Roy. Soc. Med. Sect. Odont. Proc., **42:** 815-29, Oct. 1949.
15. Ireland, R. L. Ammoniacal silver nitrate as a sterilising agent for deep seated decay in deciduous teeth. Am. Dent. A. J., **26:** 871-8, June 1939.
16. ——. The treatment of deep carious areas in the primary and young permanent teeth by means of ammoniacal silver nitrate. Mich. S. Dent. Soc. J., **24:** 187-8, Aug. 1942.
17. Lawyer, Arlette, Bibby, B. G., and Zander, H. A. Some observations relating to the use of streptothrycin in the mouth. J. Dent. Res., **25:** 181-2, June 1946.
18. Miller, W. D. Comparative rapidity with which different antiseptics penetrate decalcified dentin; or what antiseptic should be used for sterilizing cavities before filling? Dent. Cosmos, **33:** 337-47, May 1891.
19. Miller, O., and Maeglin, G. Sterilization of dentin on vital teeth. Abstr. Internat. Dent. J., **3:** 170-1, Dec. 1952.
20. Muntz, J. A., Dorfman, Albert, and Stephan, R. M. In vitro studies on sterilization of carious dentin. I. Evaluation of germicides. Am. Dent. A. J., **30:** 1893-1900, Dec. 1, 1943.
21. Nuckolls, James. Our empiric cavity sterilization. Calif. S. Dent. A. J., **27:** 260-6, Sept.-Oct. 1951.
22. Rabinowitch, B. Z. Ammoniacal silver nitrate: a study of its value in operative dentistry today. J. Dent. Child., **17:** 22-30, 2nd Quar. 1951.
23. Rickert, U. G. Advantages and disadvantages of reduced silver in dental practice. Nat. Dent. A. J., **6:** 930-5, Oct. 1919.
24. Rosenstein, S. N. Studies in the conservation of deciduous and early permanent teeth. J. Dent. Res., **16:** 29-31, Feb. 1937.
25. Ross, W. S. Diffusion experiments with silver nitrate. Brit. Dent. J., **71:** 379-83, Dec. 15, 1941.
26. Seelig, Alexander, and Lefkowitz, William. Pulp response to filling materials. N. Y. S. Dent. J., **16:** 540-53, Dec. 1950.
27. Seltzer, Samuel. The bacteriologic status of the dentin after cavity sterilization. Am. Dent. A. J., **27:** 1799-801, Nov. 1940.
28. ——. The comparative value of various medicaments in cavity sterilization. Am. Dent. A. J., **28:** 1844-52, Nov. 1941.
29. ——. Effective duration of some agents used for dentin sterilization. J. Dent. Res., **21:** 115-23, Apr. 1942.
30. ——. Effectiveness of antibacterial agents used in cavity sterilization. J. Dent. Res., **21:** 269-77, June 1942.

31. ——. Medication and pulp protection for the deep cavity in a child's tooth. Am. Dent. A. J., **39:** 148–57, Aug. 1949.
32. Seltzer, Samuel, and Werther, Lester. Conservative silver nitrate treatment of borderline cases of deep dental caries. Am. Dent. A. J., **28:** 1586–94. Oct. 1941.
33. Sheppard, Mary S. The bactericidal action of pure metals and metal fillings. Dent. Cosmos, **77:** 968–74, Oct. 1935.
34. Stamps, H. F. The testing of dentin sterilising agents. Mich. Univ. School Dent. Alumni Bul., **55:** 16–24, Oct. 1953.
35. Stephan, R. M. Consultant symposium: our empiric cavity sterilization—Part III. N. Y. S. Dent. J., **17:** 185–9, May 1951.
36. Stephan, R. M., Muntz, J. A., and Dorfman, Albert. In vitro studies on sterilization of carious dentin. III. Effective penetration of germicides into carious lesions. Am. Dent. A. J., **30:** 1905–8, Dec. 1, 1943.
37. Thomas, B. O. A. Penetration of phenol in tooth structure. J. Dent. Res., **20:** 435–45, Oct. 1941.
38. Zander, H. A. Bacteria in dentin after cavity preparation. Ill. Dent. J., **9:** 207–9, June 1940.
39. Zander, H. A., and Smith, H. W. Penetration of silver nitrate into dentin. II. J. Dent. Res., **24:** 121–8. June–Aug. 1945.

THE AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

APPLICATION FOR MEMBERSHIP

I am interested in becoming a member of the American Society of Dentistry for Children.

NAME.....DEGREE.....

ADDRESS.....

.....

If you are a dentist or physician, you must be a member in good standing of your local dental or medical Society.

If you wish associate membership, please indicate affiliate society membership.

Send this application to:

American Society of Dentistry for Children
Mt. Royal and Guilford Avenues
Baltimore 2, Maryland

Children's Dental Health Week

February 6 to 10, 1956

Since the purpose of the American Society of Dentistry for Children as expressed in the Constitution and By-Laws is "The advancement and dissemination to the profession and the public of knowledge of all phases of dentistry for children" every member of the ASDC, state and local units of the ASDC; and the ASDC itself, should participate in Children's Dental Health Week activities.

Many private practitioners are too busy to regularly give time during the year to promote dental public health programs but can collaborate during a week specifically designated for community dental health programs. However, leadership and guidance is required to stimulate the participation of practicing dentists. In most cities and in most states, the Council on Dental Health of the official Dental Society directs Children's Dental Health Week projects. In other localities, health departments lead the way. Unfortunately in some communities there are neither Councils on Dental Health nor health departments prepared to organize such programs to further dental health among children.

In presenting this statement the Committee on Public Relations and Publicity therefore offers suggestions for units operating in an area where there is an active Council on Dental Health or official agency and for units functioning in a community where leadership is lacking for Children's Dental Health Week.

Where there is a Council on Dental Health, members of the ASDC are urged to volunteer their services during the first week of February.

The Council on Dental Health can obtain educational material from the ADA and will assign specific responsibilities to all participants. Suggestions and or material for the dental office as well as for community efforts, may be obtained by writing to the American Dental Association. Special materials have been prepared for Children's Dental Health Week. This "Week" offers an opportunity for community service for children's dental health to promote the principle of earlier, more and better dentistry for children.

If one practices in a community where there is no active committee of the Dental Society or in a community not reached by a component unit of the State or County Dental Society, write to J. M. Wisan, D.D.S., 632 City Hall Annex, Philadelphia 7, Pa. When writing for suggestions, give following information:

1. Population of community.
2. Existing community dental programs.

3. Available radio and television stations.
4. Number of dentists expected to participate in program.
5. Number of dentists practicing in community.
6. Budget available for program.
7. What specific problems in children's dentistry do you have in your community?
8. Is the public water supply fluoridated?
9. Is there an active PTA or other women's organization?
10. Is there an active health council or coordinating health committee?
11. Are hospitals interested in children's dentistry?

In order to have ample time to prepare for program in February 1956, it is suggested that all inquiries be made on or before November 1, 1955.

NOTICE

The next meeting of the American Board of Pedodontics will be held February 2–4, 1956 at the W. K. Kellogg Foundation Institute, University of Michigan, Ann Arbor, Michigan.

RALPH L. IRELAND, Secretary
University of Nebraska
Lincoln 8, Nebraska

American Society of Dentistry for Children

OFFICERS 1954–55

WILLARD T. HUNNICUTT ..... *President*
HENRY M. WILBUR ..... *President-Elect*
LAWRENCE R. BURDGE ..... *Vice-President*
ALBERT L. ANDERSON ..... *Secretary-Treasurer*
ALFRED E. SEYLER ..... *Editor*

EXECUTIVE COUNCIL

WILLARD T. HUNNICUTT — ALBERT L. ANDERSON — GEORGE W. TEUSCHER '55
HENRY M. WILBUR — ALFRED E. SEYLER — HAROLD A. MAXMEN '55
LAWRENCE R. BURDGE — HAROLD K. ADDELSTON '55 — HUGH KEENAN '56
C. FRANK TUMA '56 — LAREN W. TEUTSCH '56

STANDING COMMITTEES

Membership and State Units

HENRY WILBUR, *Chairman* '55
129 East Broadway, Louisville, Kentucky
EARL L. LAMPSHIRE '55
708 Sharp Building, Lincoln 8, Nebraska
FREDERICK R. SHIERE '56
Tufts College Dental School, 136 Harrison Avenue, Boston, Massachusetts
GEORGE HIGUE '57
4327 East Gage Avenue, Bell, California
REGINA DAVID '58
10465 Carnegie Avenue, Cleveland, Ohio
DAVID L. WEBBER '59
1618 Main St., Springfield 3, Massachusetts

Public Relations and Publicity

JACK M. WISAN, *Chairman* '58
Chief Division, Dental Health, Department of Public Health, City Hall Annex, Philadelphia 7, Pa.
GORDON H. ROVELSTAD '57
612 Professional Building, Elgin, Illinois
FRANCIS W. SUMMERS '57
6225 Western Avenue, Los Angeles, California
IRWIN BEECHEN '55
2929 Summit Street, Oakland, California
CHARLES OXAR '59
7625 Northeast 2nd Avenue, Miami, Florida

Professional Relations

PAUL SYDOW, *Chairman* '57
29 Lincoln Street, Framingham, Massachusetts
ROY WOLFF '58
101 South Meremac, Clayton, Missouri
FRANK B. GARDNER '56
Medical Arts Building, Scranton, Pennsylvania
GEORGE MORGAN '55
2039 North Prospect Avenue, Milwaukee, Wisconsin
ROBERT W. BURCHESKY '59
135 Westminster Place, Utica, New York

Schools and Dental Boards

WILLIAM DEMERITT, *Chairman* '59
University of North Carolina, School of Dentistry, Chapel Hill, North Carolina
WILLIAM BROWN '56
University of Michigan, School of Dentistry, Ann Arbor, Michigan
CHARLES VINCENT '58
School of Dentistry, Medical College of Virginia, Richmond, Virginia
HAROLD K. ADDELSTON '57
424 Madison Avenue, New York 17, New York
DAVID LAW '55
University of Washington, School of Dentistry, Seattle 5, Washington

Community Dental Programs

PAUL WEBER, *Chairman* '58
Citizens National Bank Building, Englewood, New Jersey
HAROLD BERK '57
471 Commonwealth Avenue, Boston 15, Massachusetts
NORMAN OLSEN '56
The University of Kansas City, School of Dentistry, Kansas City 6, Missouri
ROBERT DOWNS '55
Colorado State Department of Health, Denver, Colorado
WENDELL WHETSTONE '59
2344 Biscayne Boulevard, Miami, Florida

Editorial and Publications

SIDNEY KRONFELD, *Chairman* '55
36 East 36th Street, New York 16, New York
GEORGE HIGUE '57
4327 Gage Avenue, Bell, California
JOSEPH J. OBST '56
8 Seventh Avenue, Brooklyn, New York